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D01H 7/885 7/90

(52) Domestic classification (Edition I):
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(56) Documents cited
None

(58) Field of search
D1D
Selected US specifications from IPC sub-class D01H

(54) Open-end spinning

(57) Discrete fibres are supplied onto a suction field (49) on a perforated surface (38) of a revolving carrier (37), and elongate fibrous formation being formed from the supplied fibres on said suction field (49) whereupon said formation is withdrawn from the suction field (49) and taken onto the open end of yarn (P) given a true twist and wound on a bobbin. According to the invention, the elongate fibrous formation on the perforated surface (38) when passing through the region of suction field (49) is shaped by force means to a fibrous fringe the maximum width of which, when reaching the suction field (49) is reduced to a pointed portion taken onto the open yarn end, withdrawn from the perforated surface (38) in counter-direction to its motion, and finally twisted.

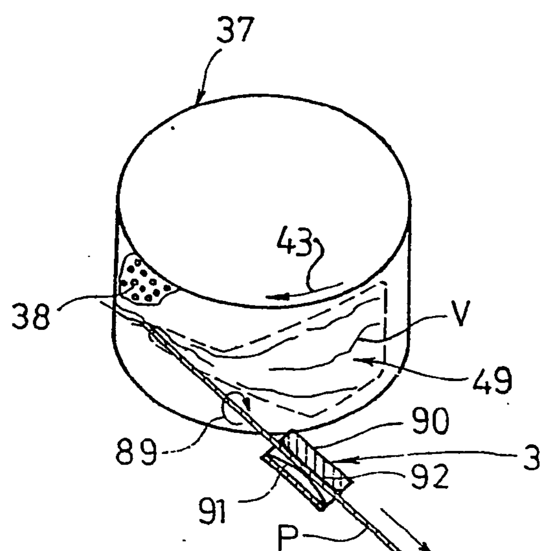

FIG. 10

The drawing(s) originally filed was (were) informal and the print here reproduced is taken from a later filed formal copy.

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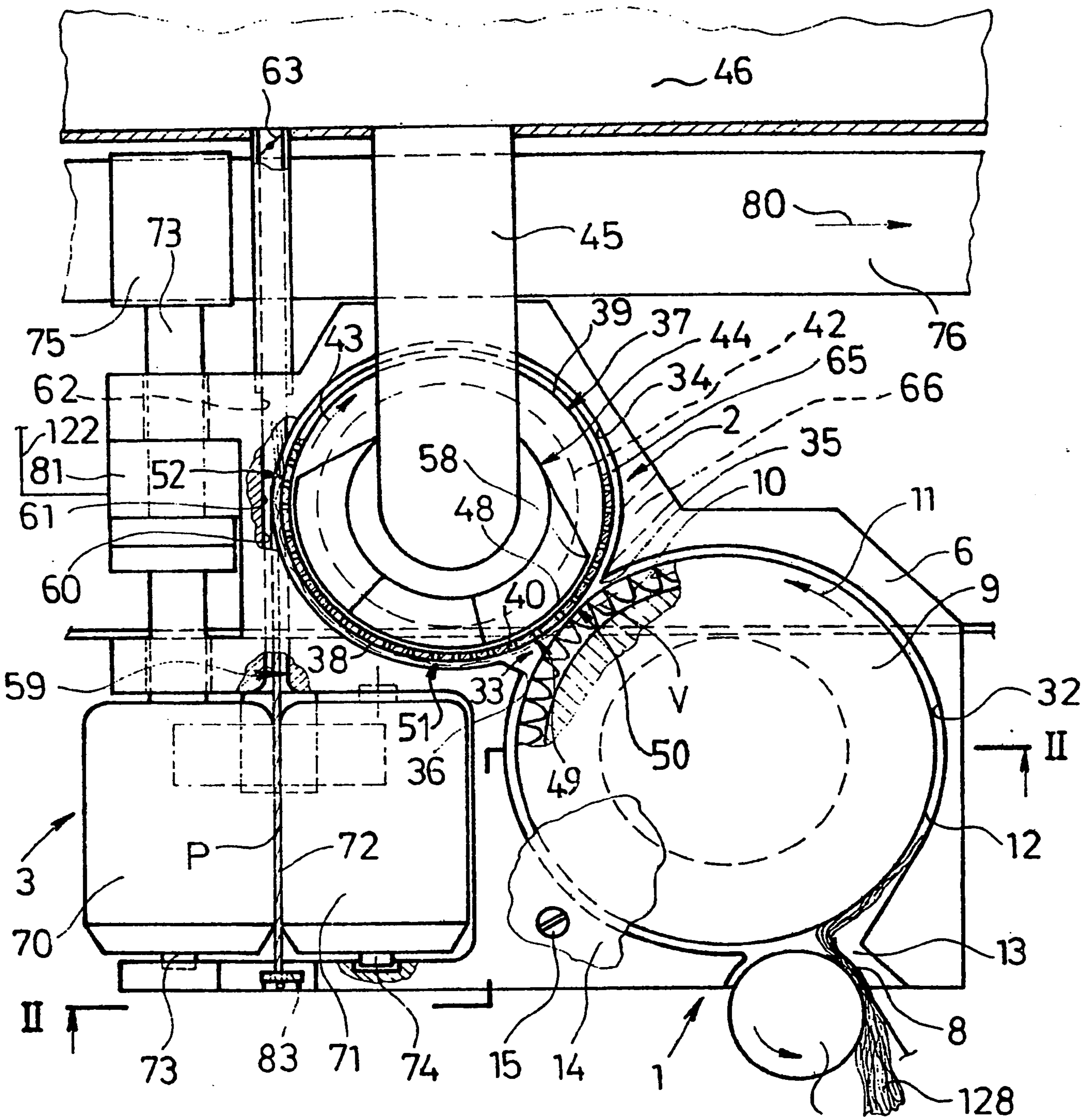
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10
61
48
11
6
60
40
9
59
38
V
32
33
51
50
36
II
49
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P
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II
73
83
71
74
15
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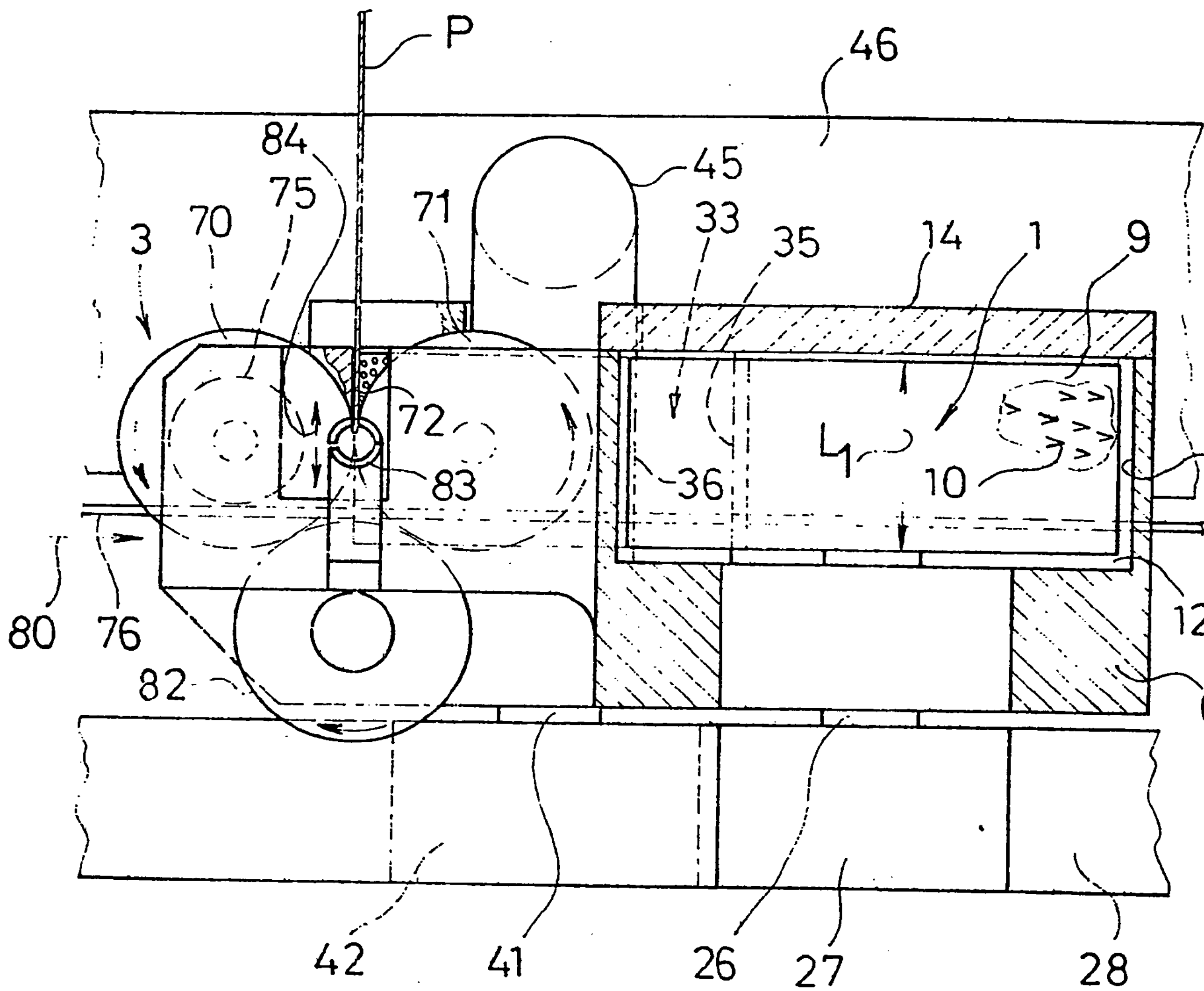
1
8
128
7

FIG. 1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L_1
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12
82
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41
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27
28

FIG. 2

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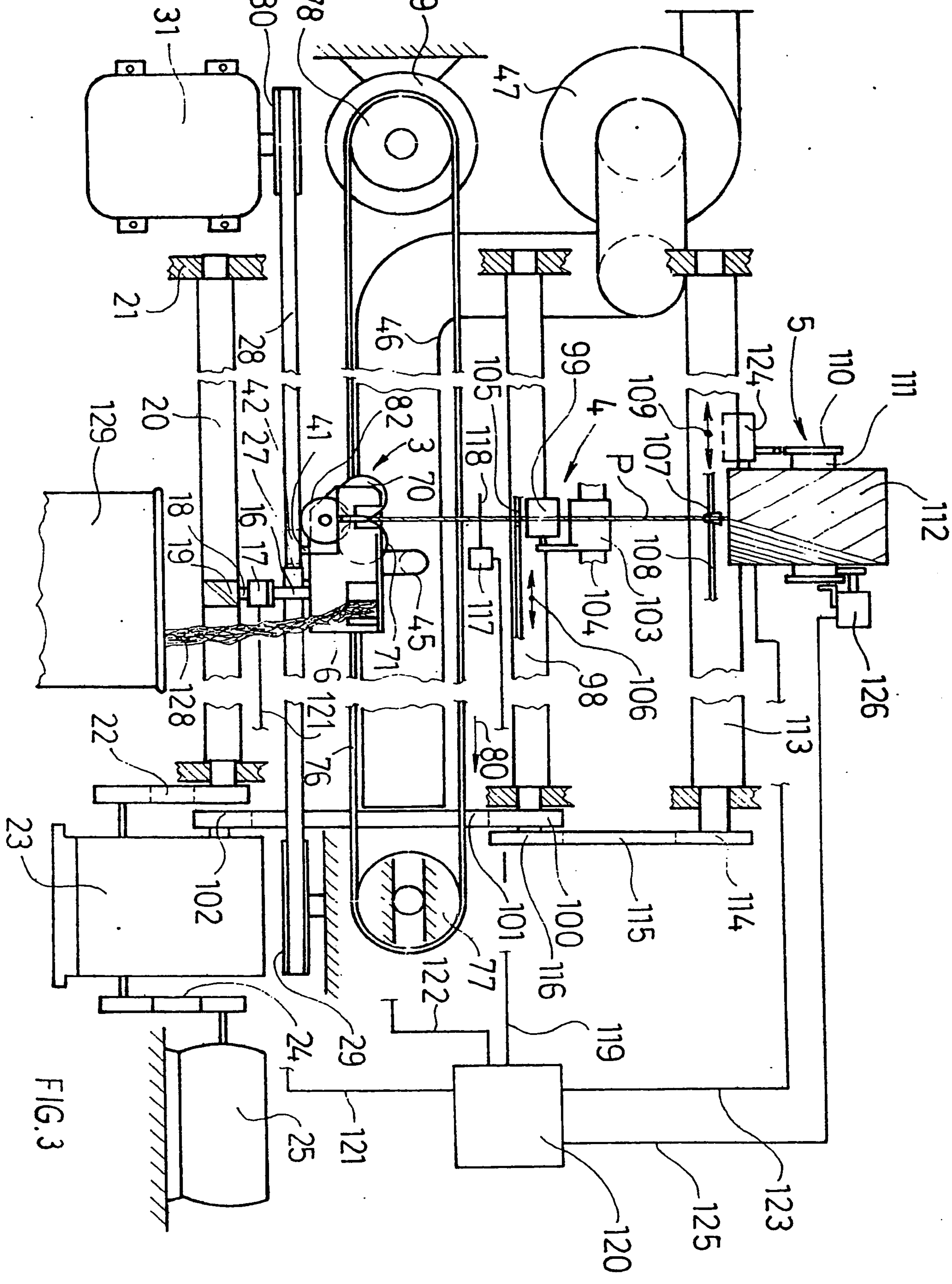


FIG.3

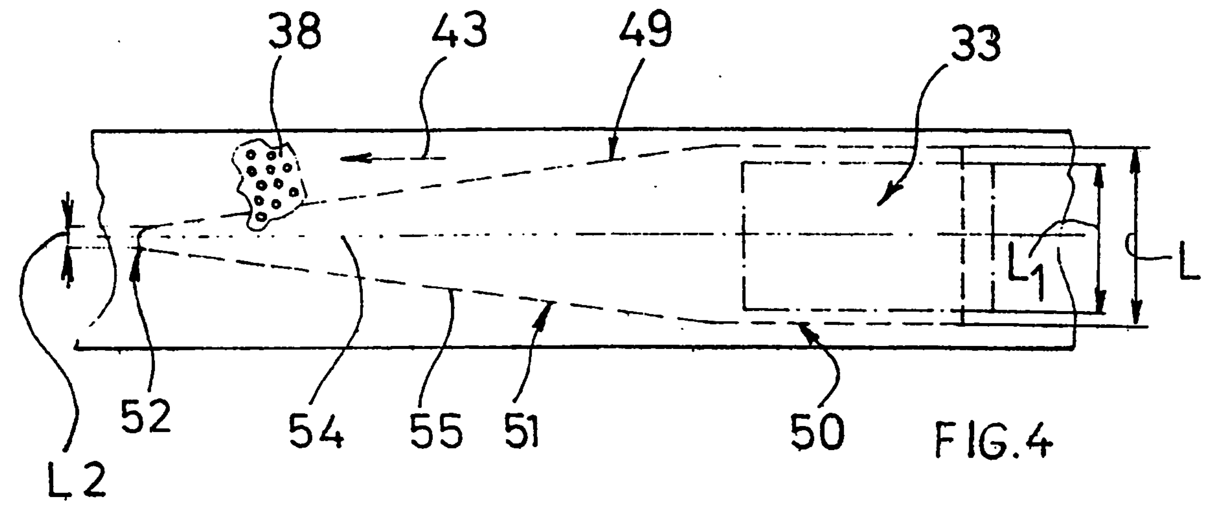


FIG.4

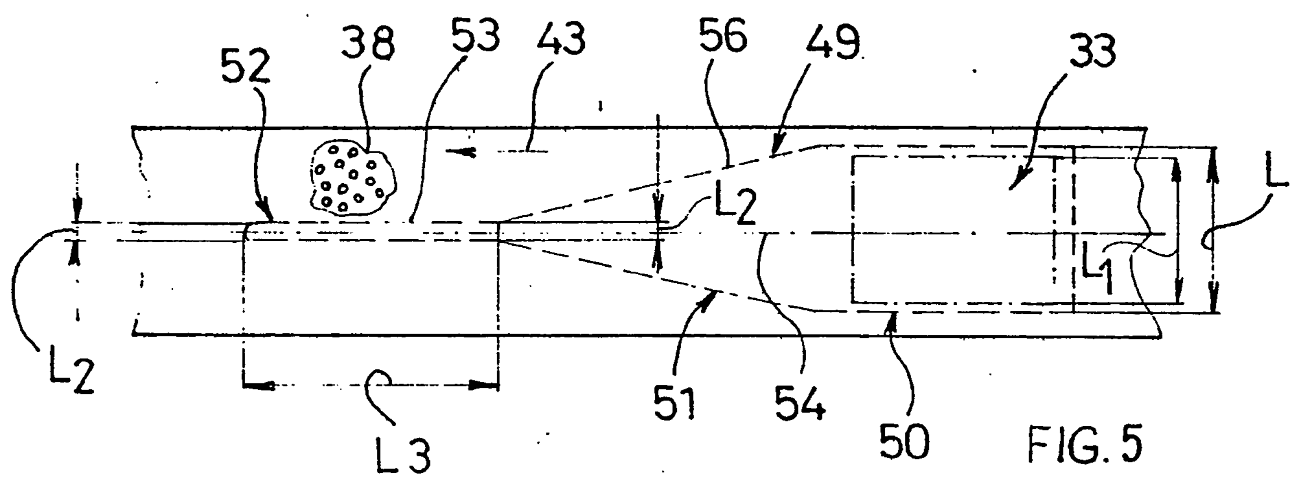


FIG.5

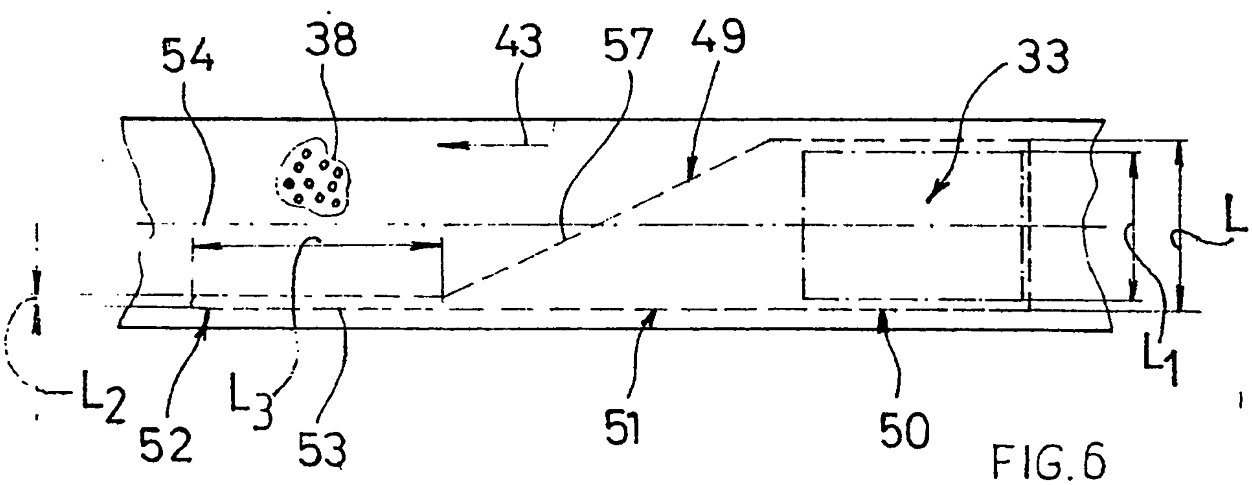


FIG.6

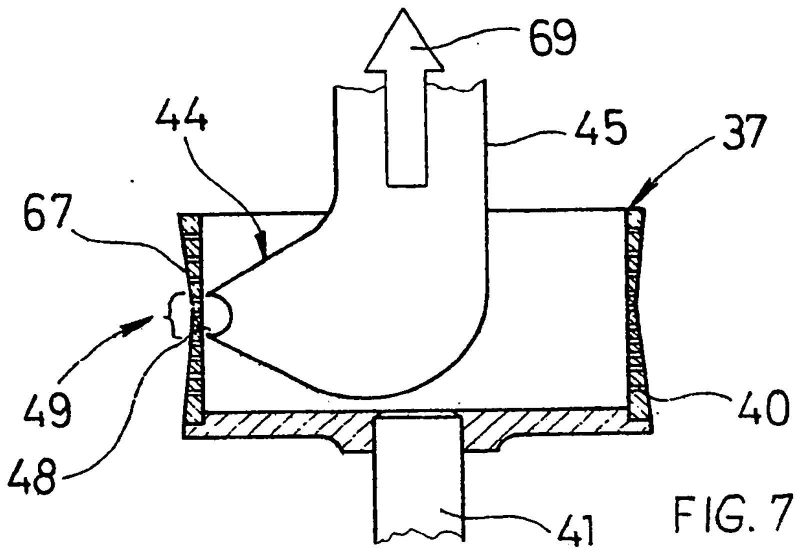
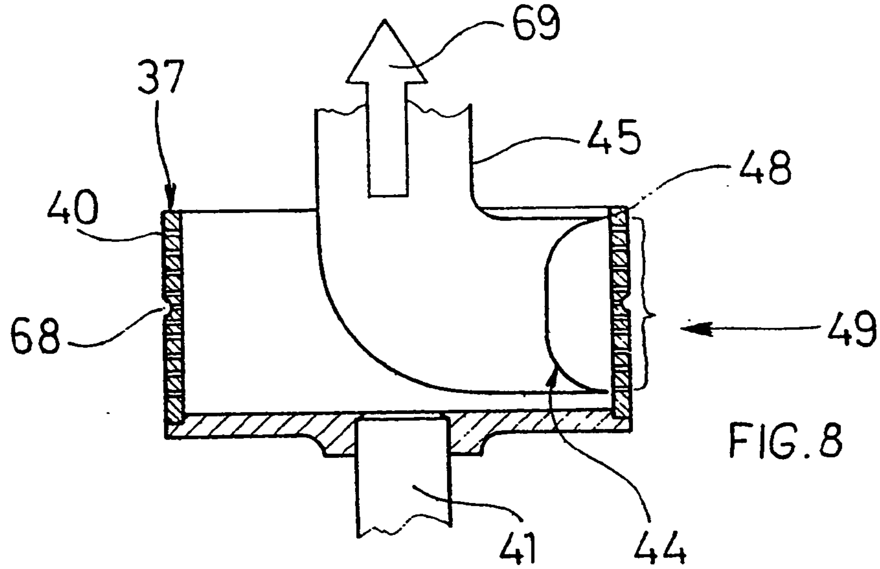


FIG. 7



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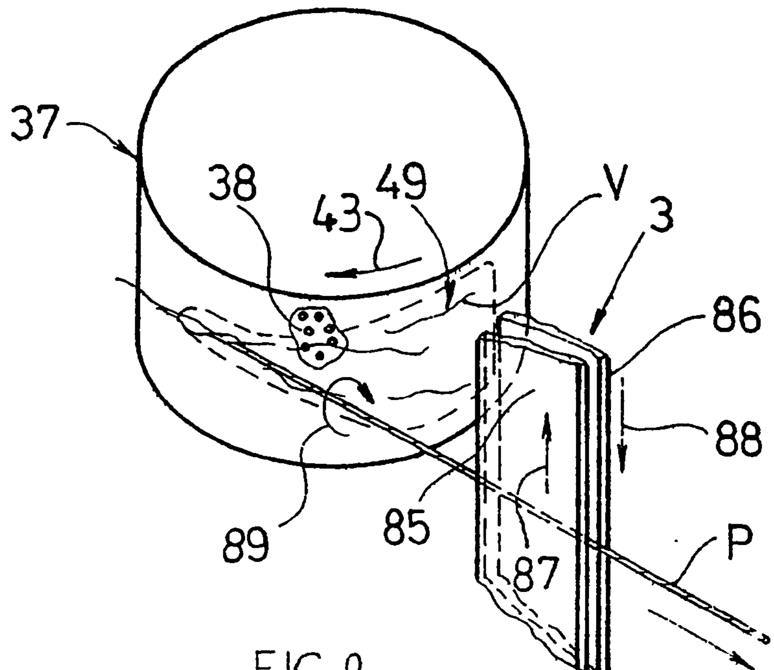


FIG. 9

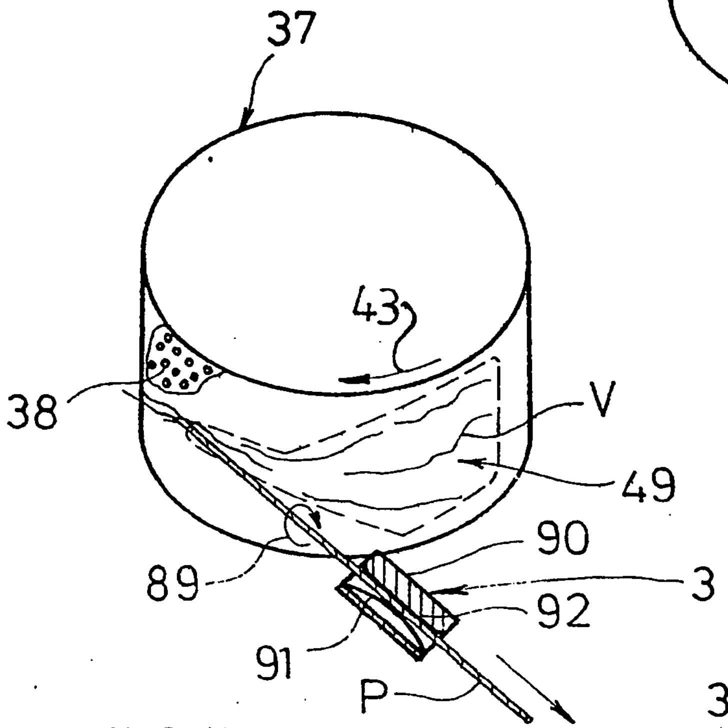
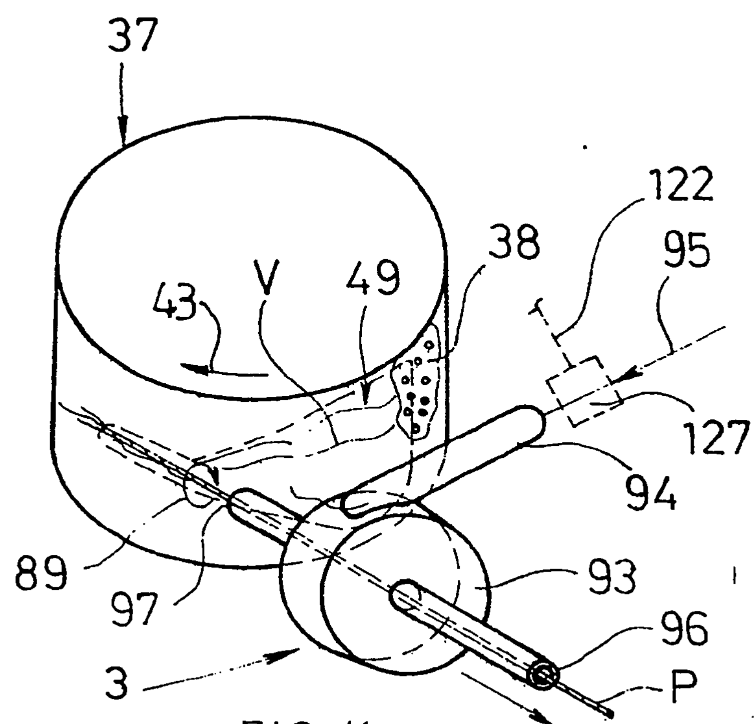


FIG. 10



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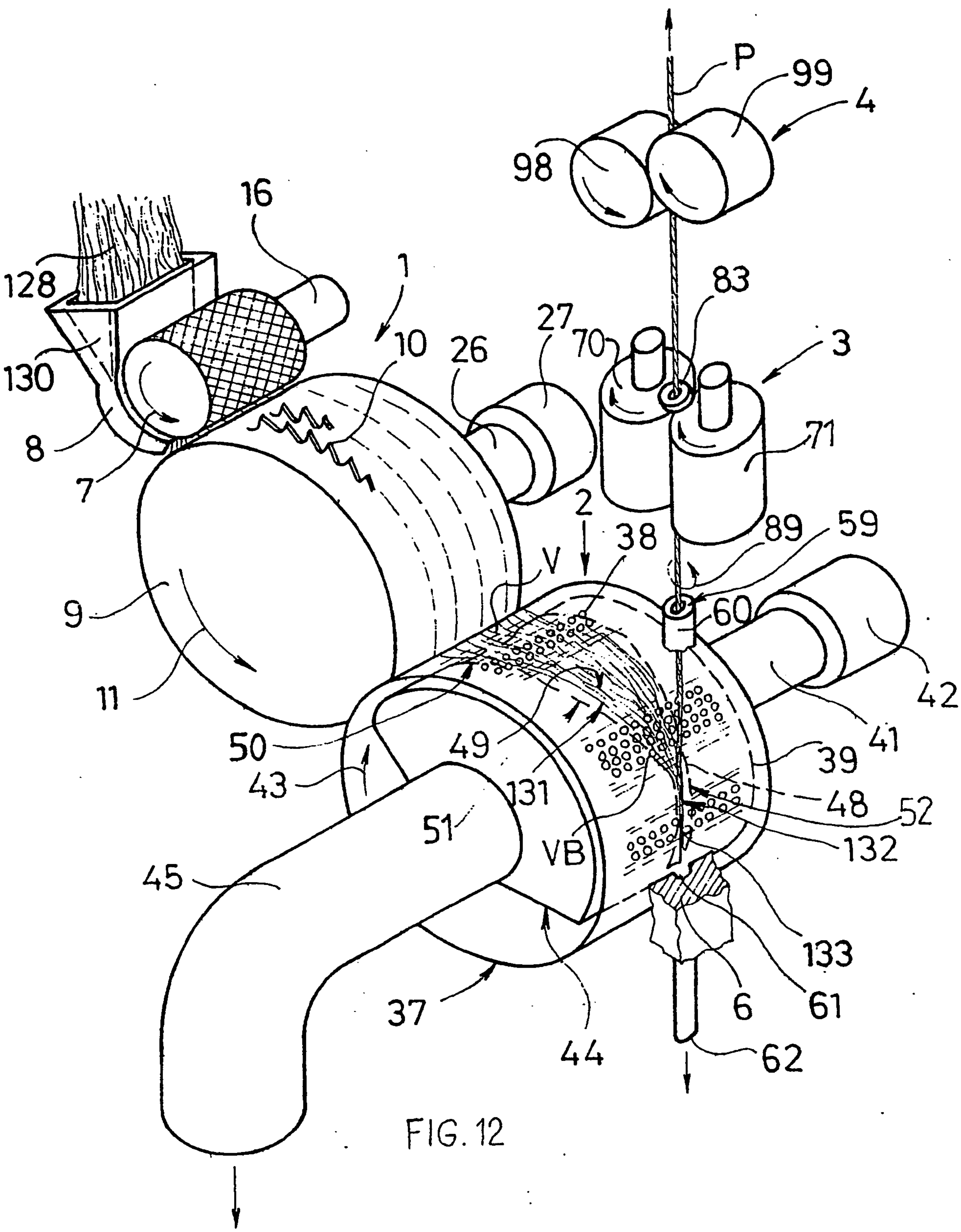
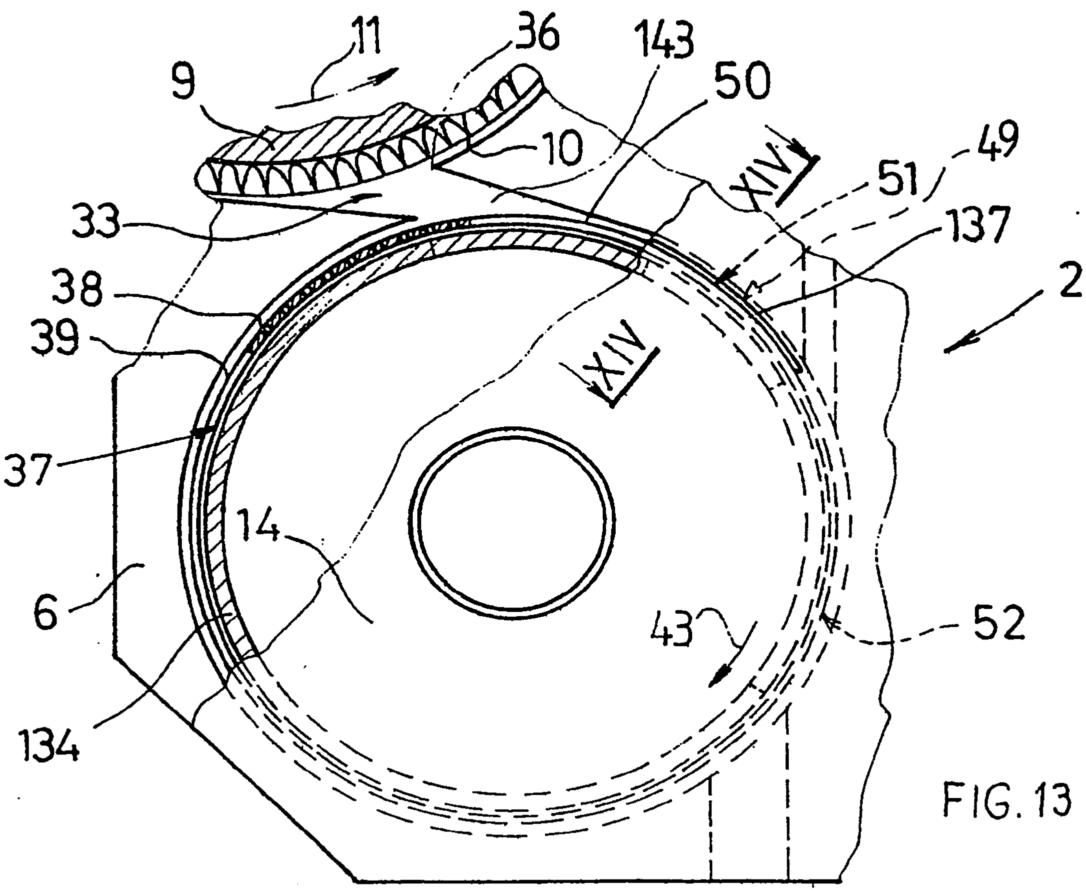

P
99
4
98
16
128
1
83
130
10
26
27
70
3
8
7
71
2
89
59
38
V
9
60
11
42
41
50
49
39
43
131
48
52
51
VB
132
45
133
37
44
6
61
62

FIG. 12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36
143
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XIV
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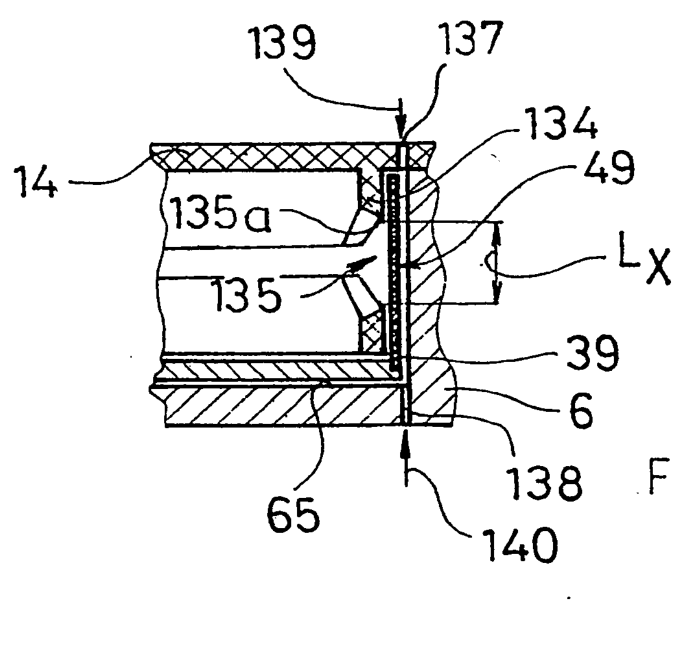
XIV
37
14
6
43
52
134

FIG. 13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135a
Lx
135
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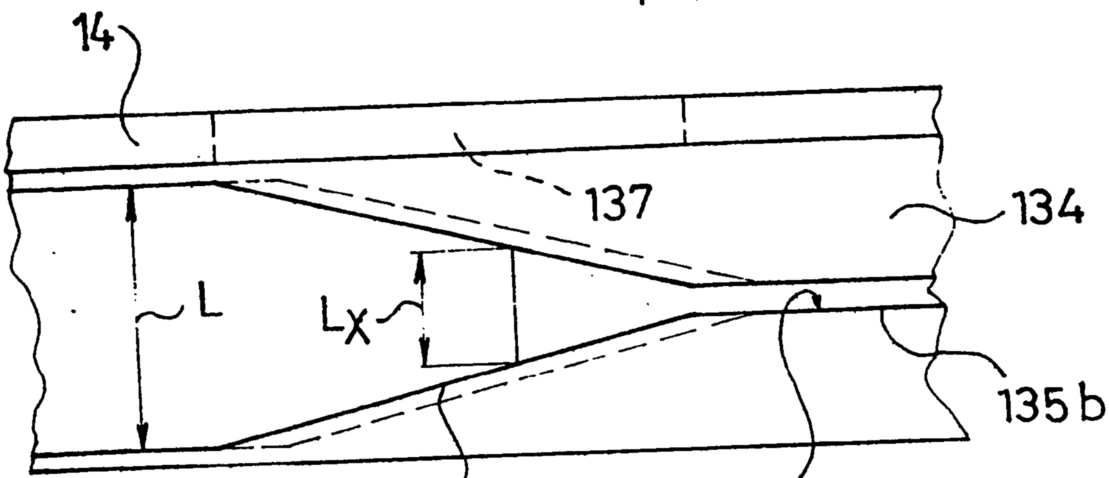
138
65
140

FIG. 14



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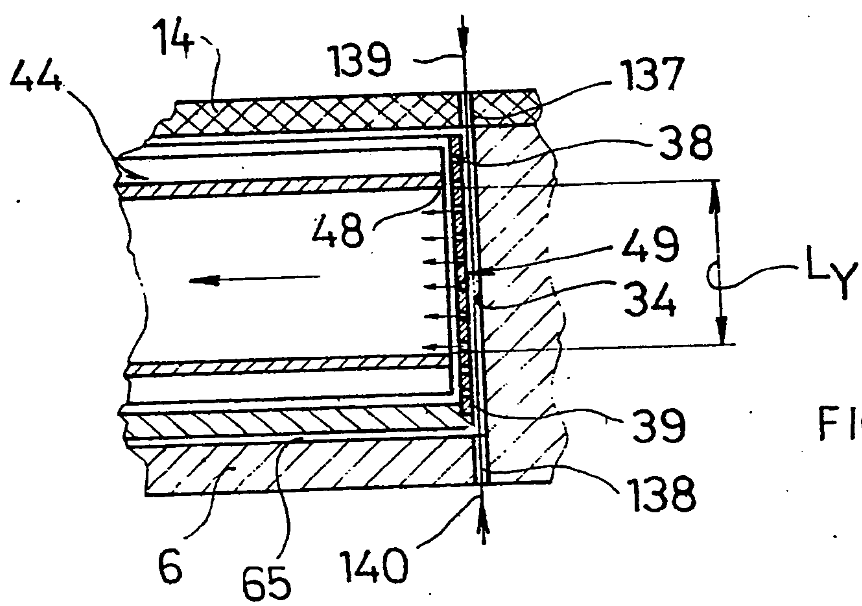

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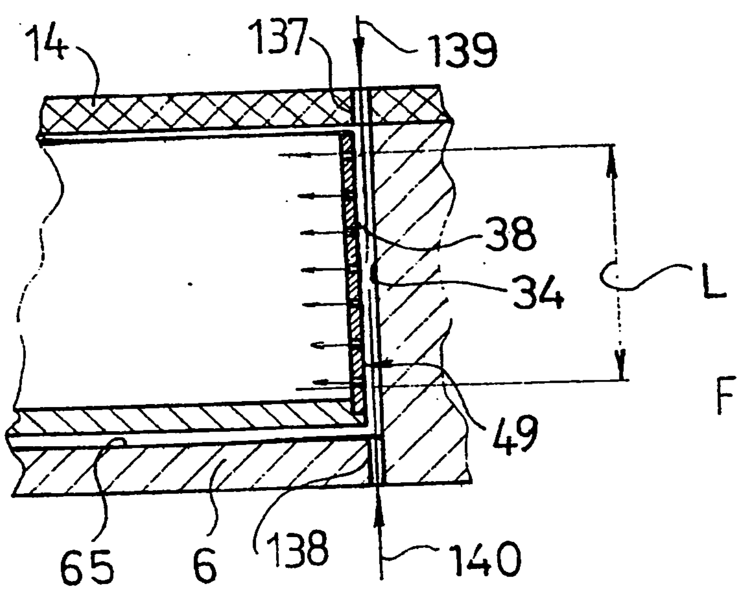

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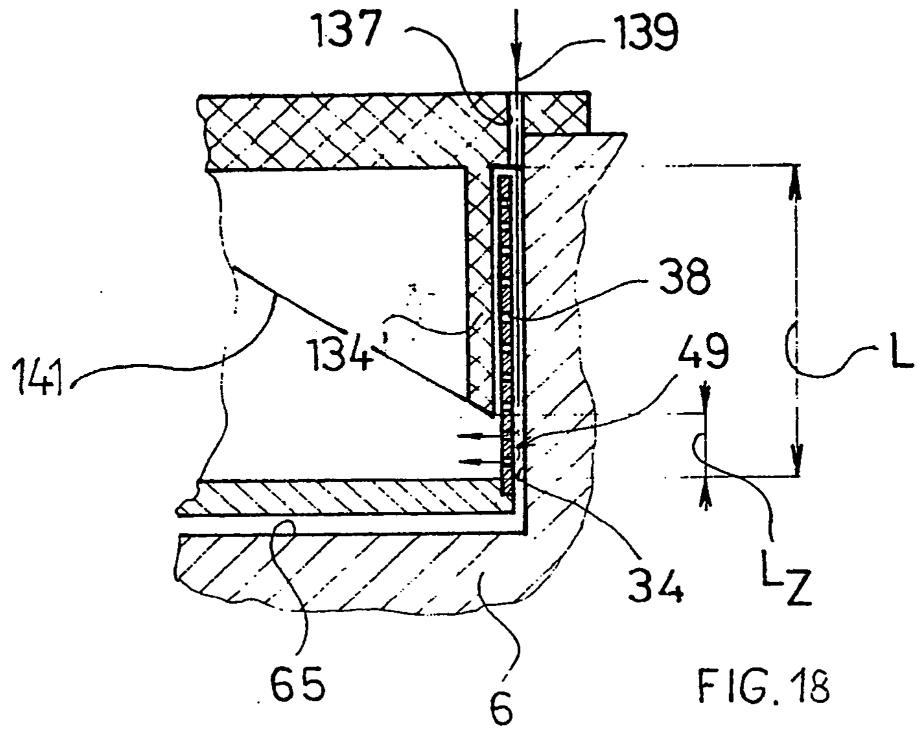
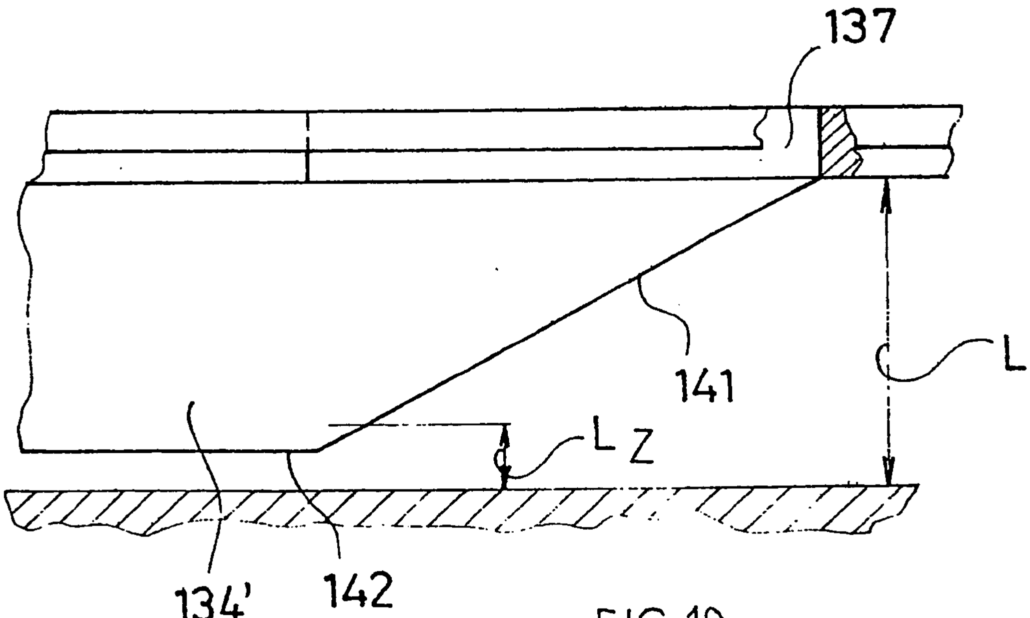


FIG. 18



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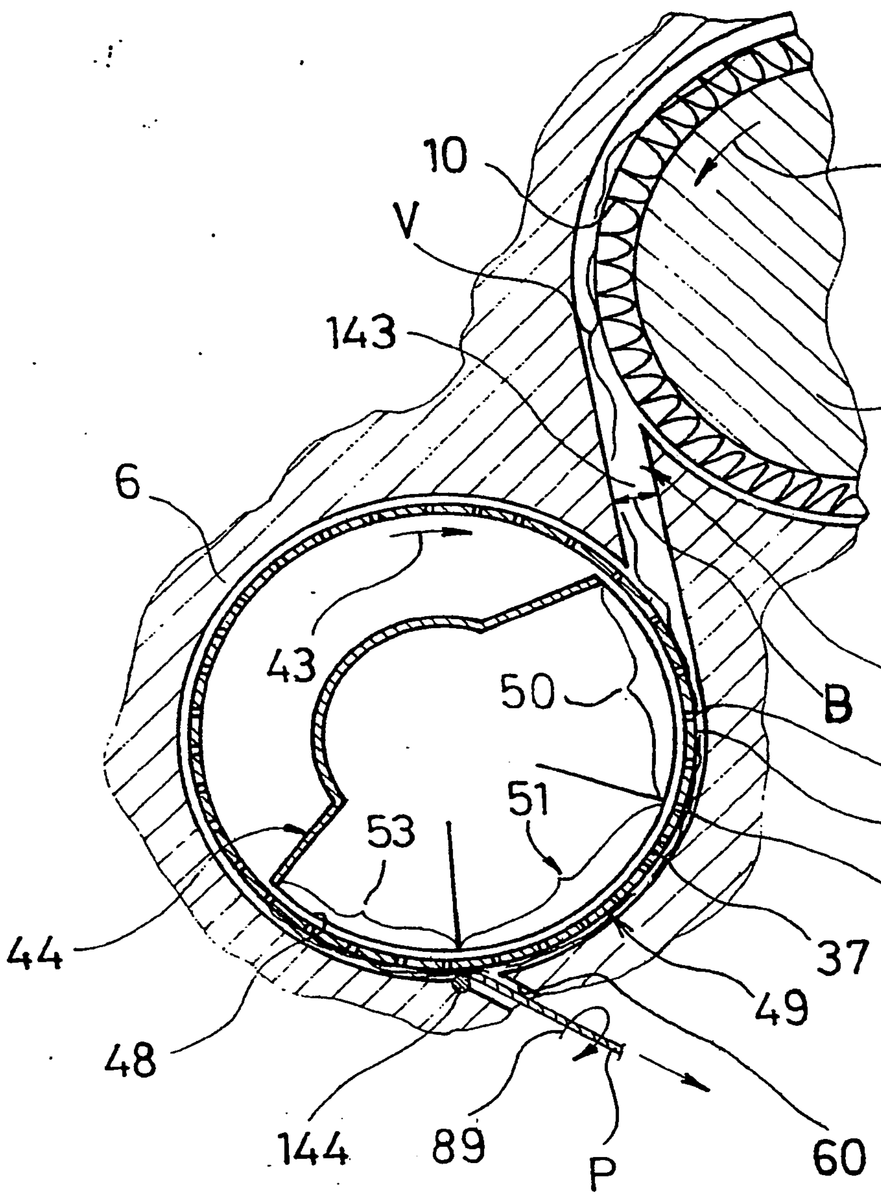
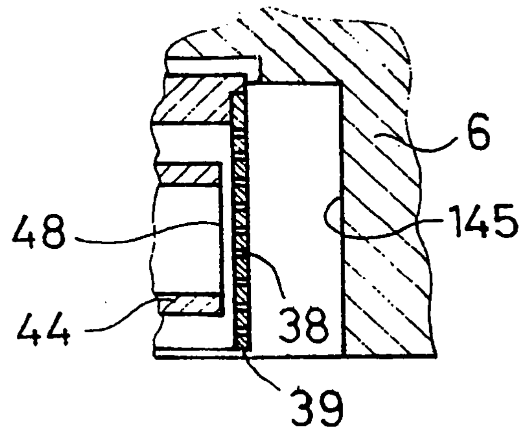


FIG. 20



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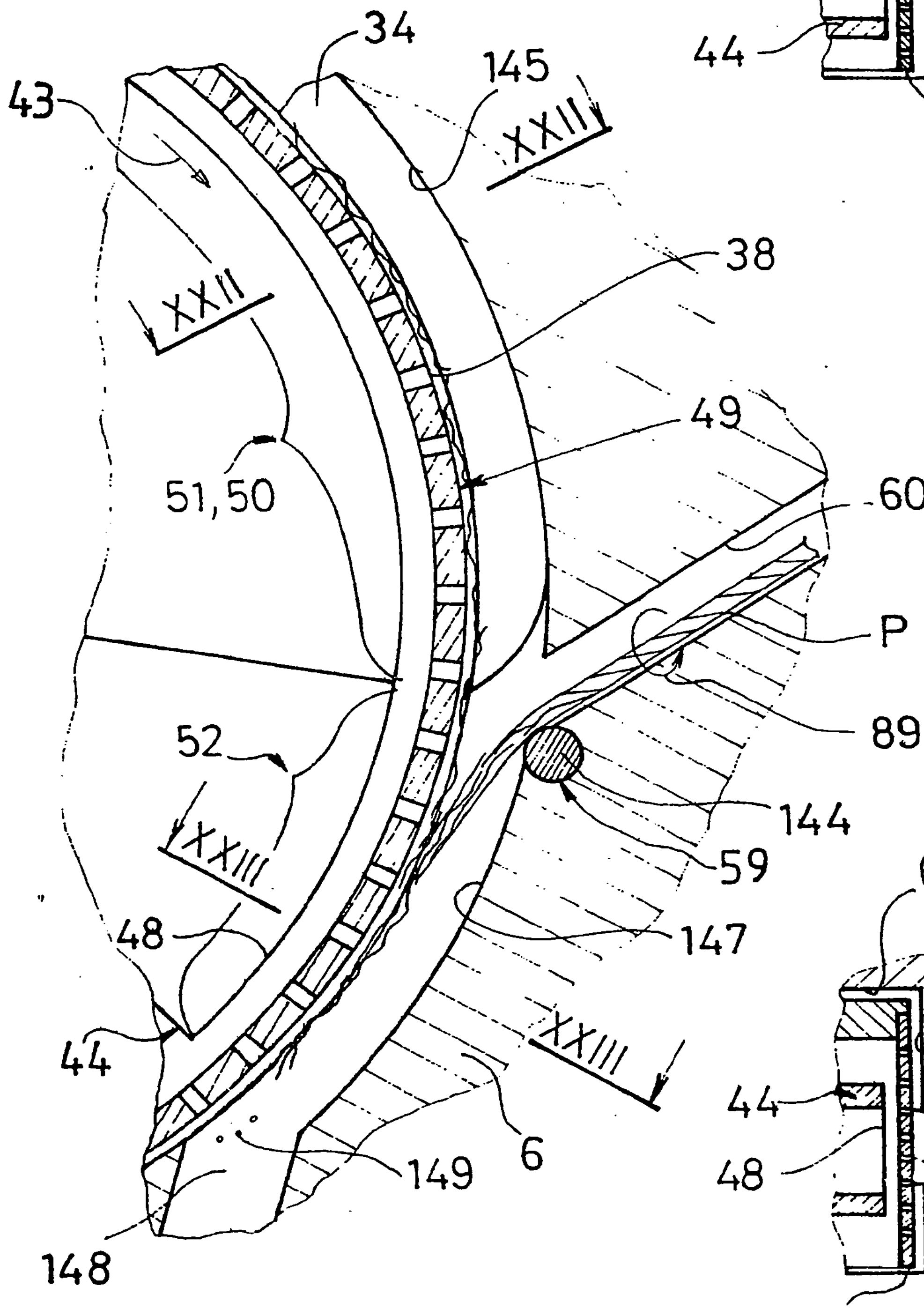

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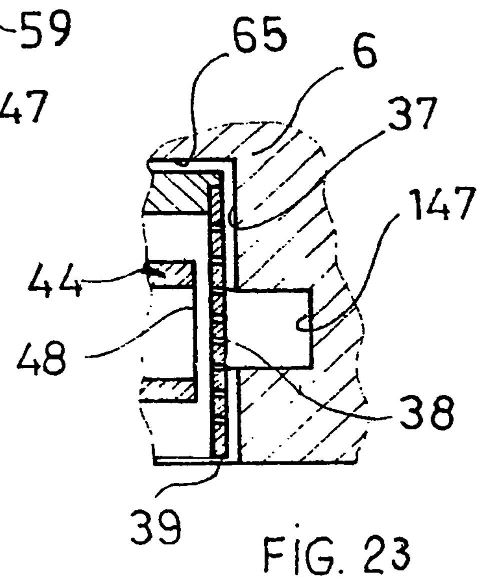

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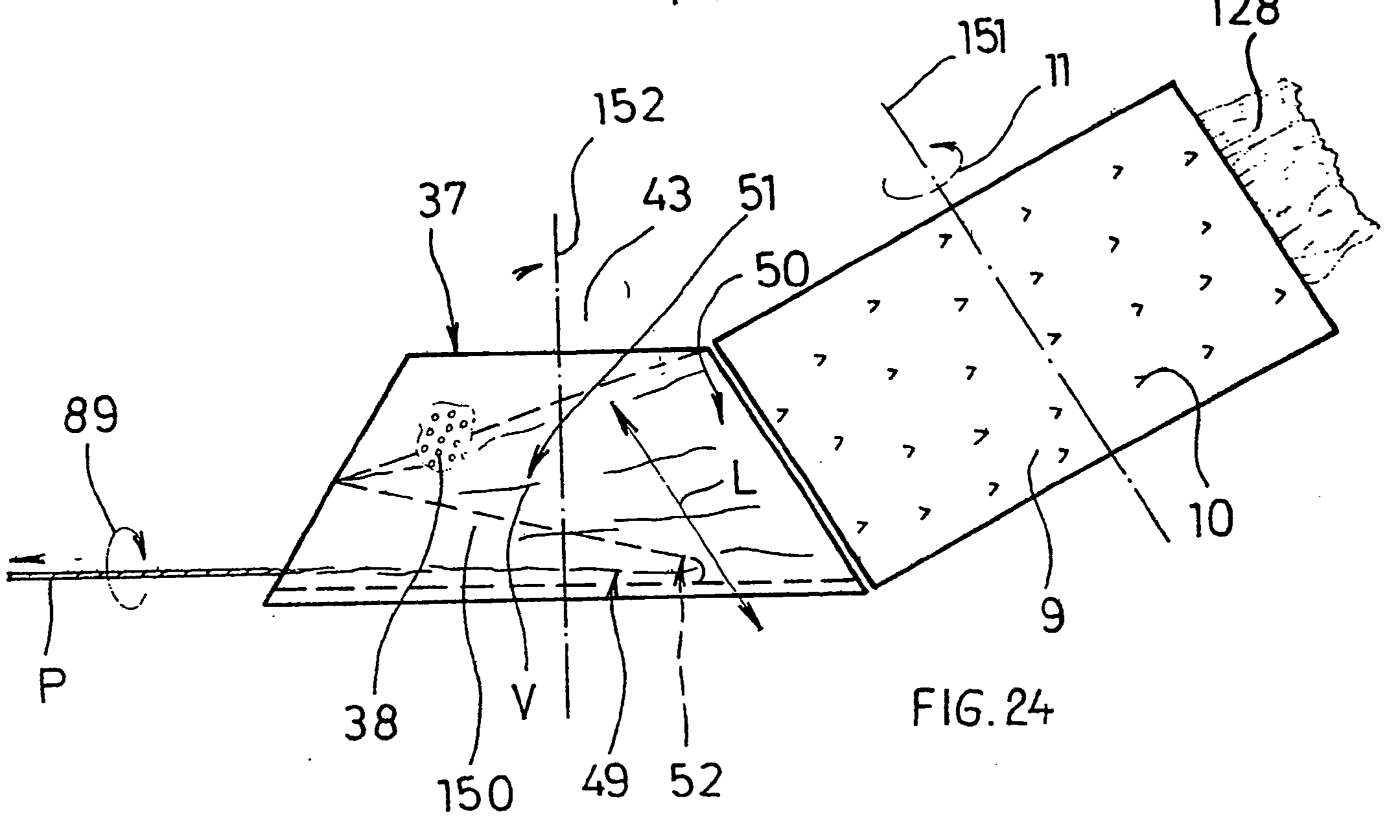
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43
51
37
50
89
L
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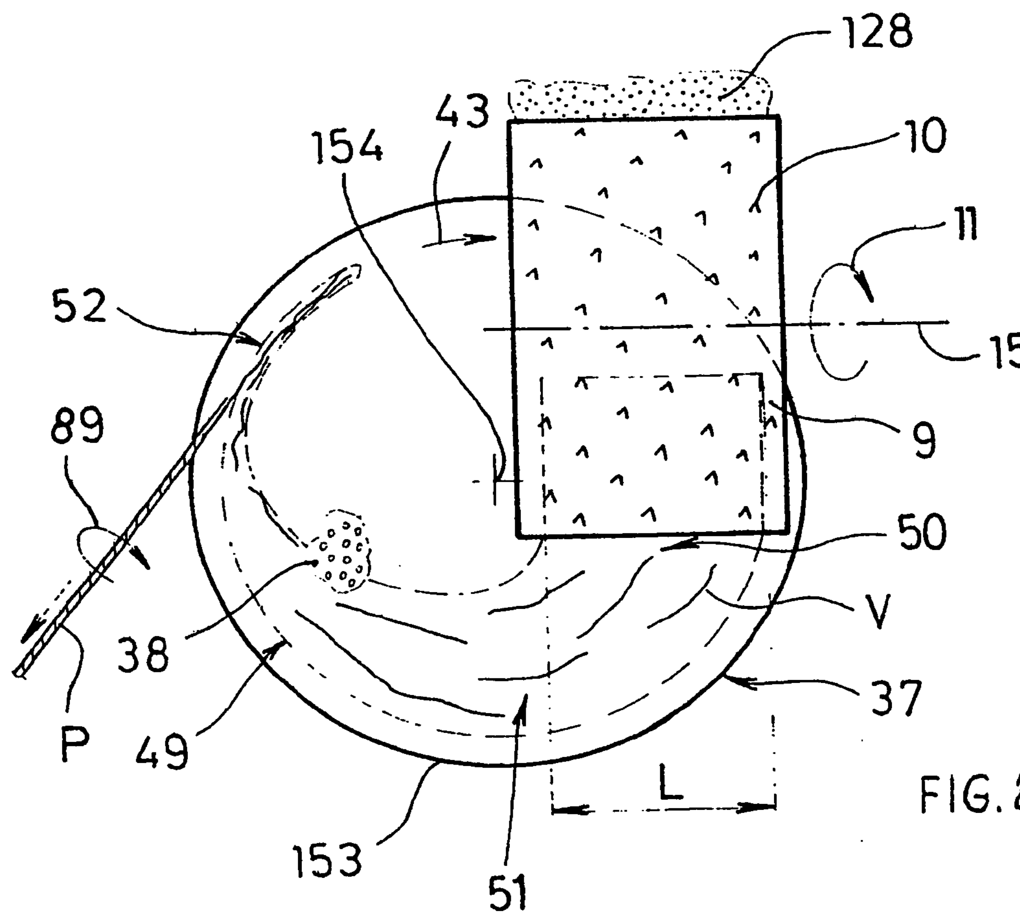
9
P
38
V
150
49
52

FIG. 24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V
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37
P
49
L
153
51

FIG. 25

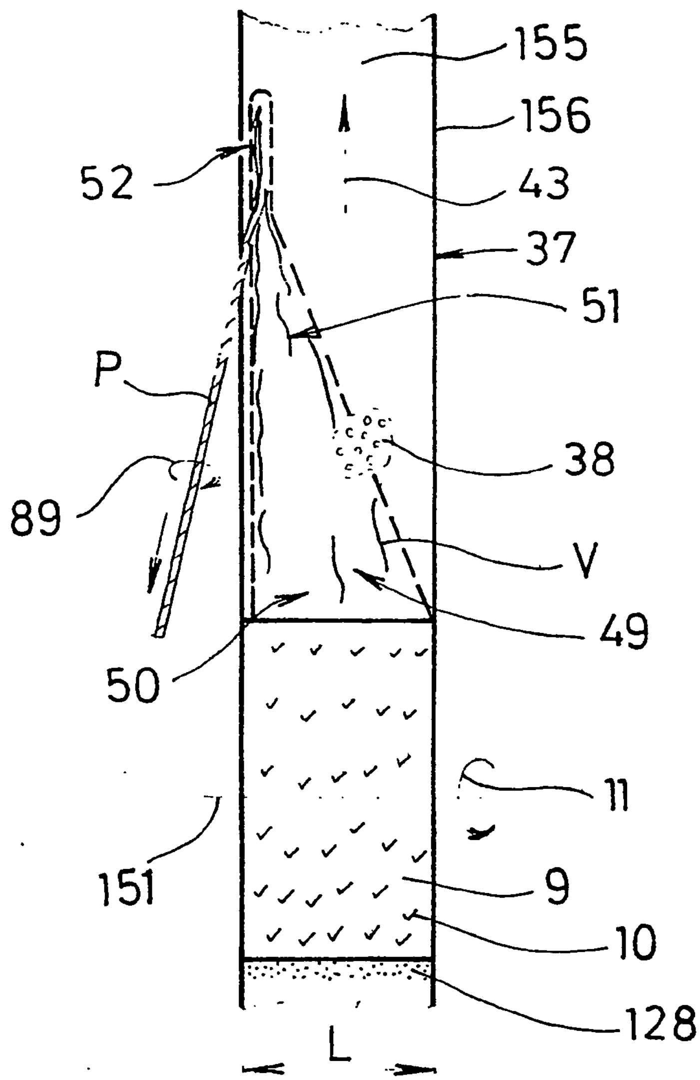

FIG. 26

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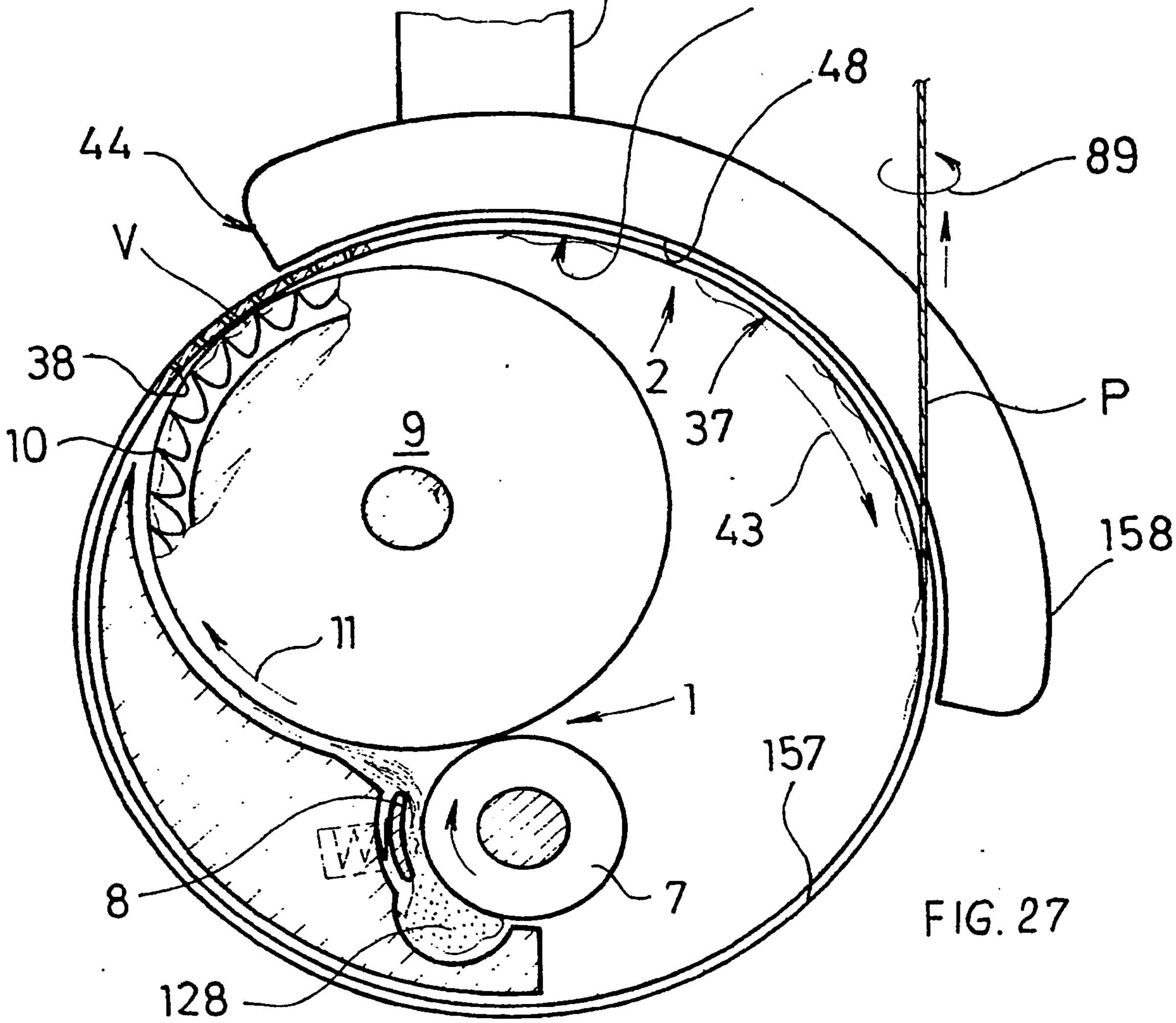

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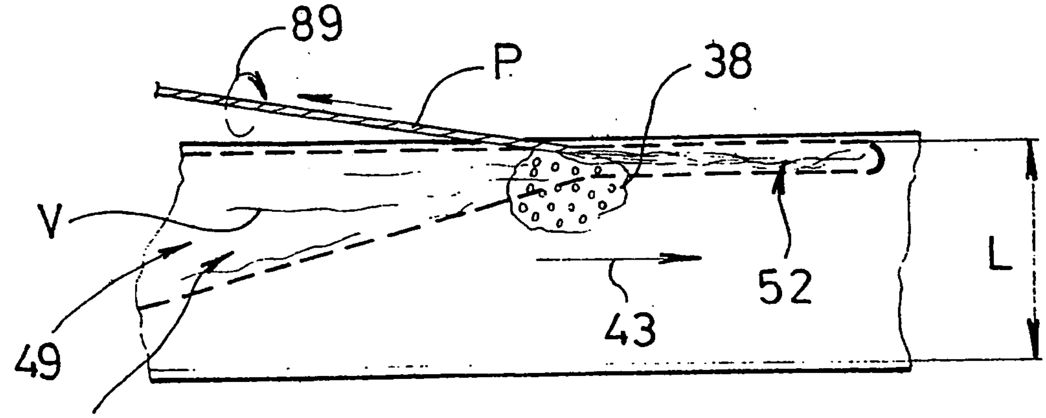

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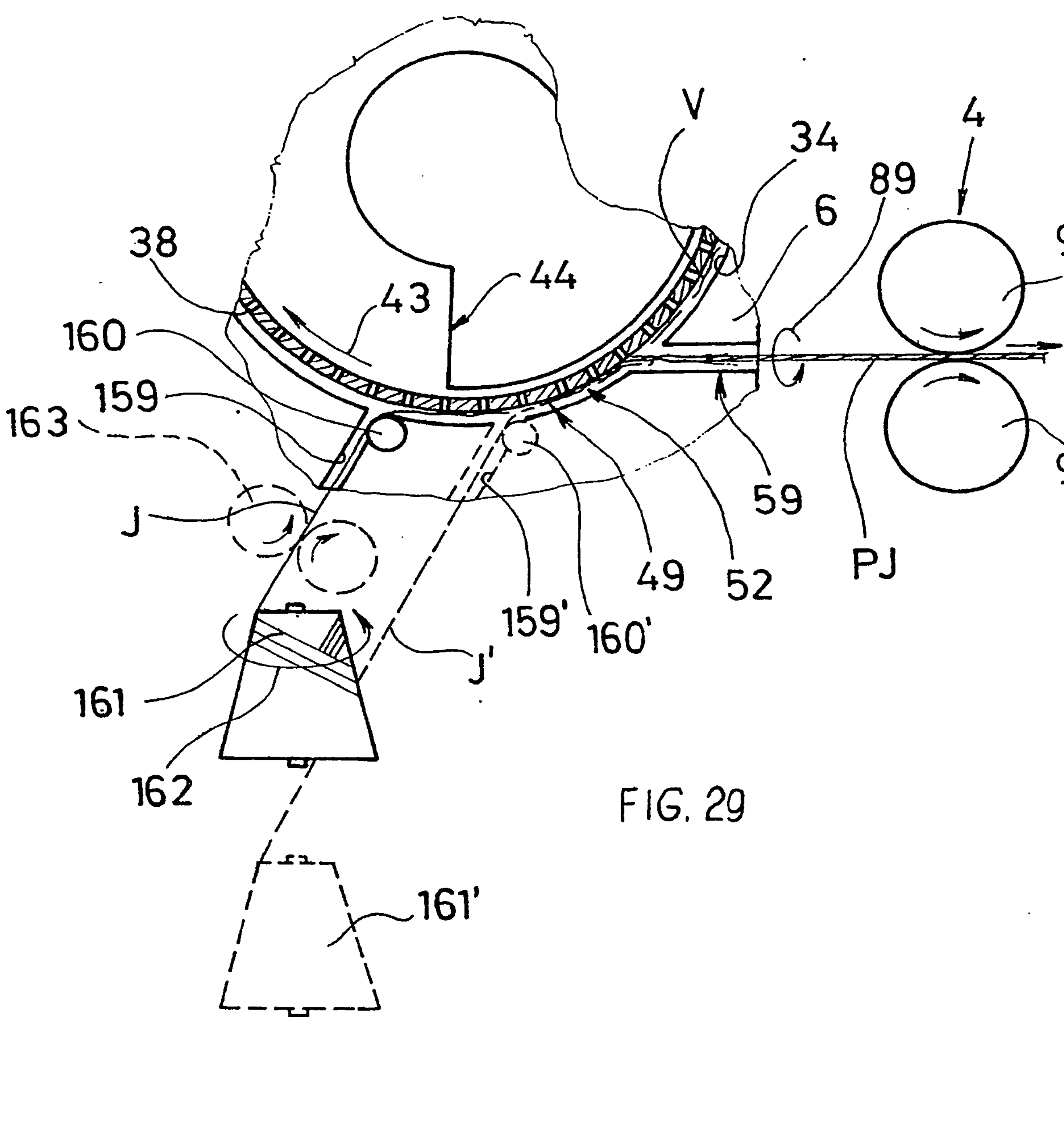
V
34
4
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6
98
38
44
43
160
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163
J
159'
160'
49
52
59
PJ
99
J'
161
162
161'

FIG. 29

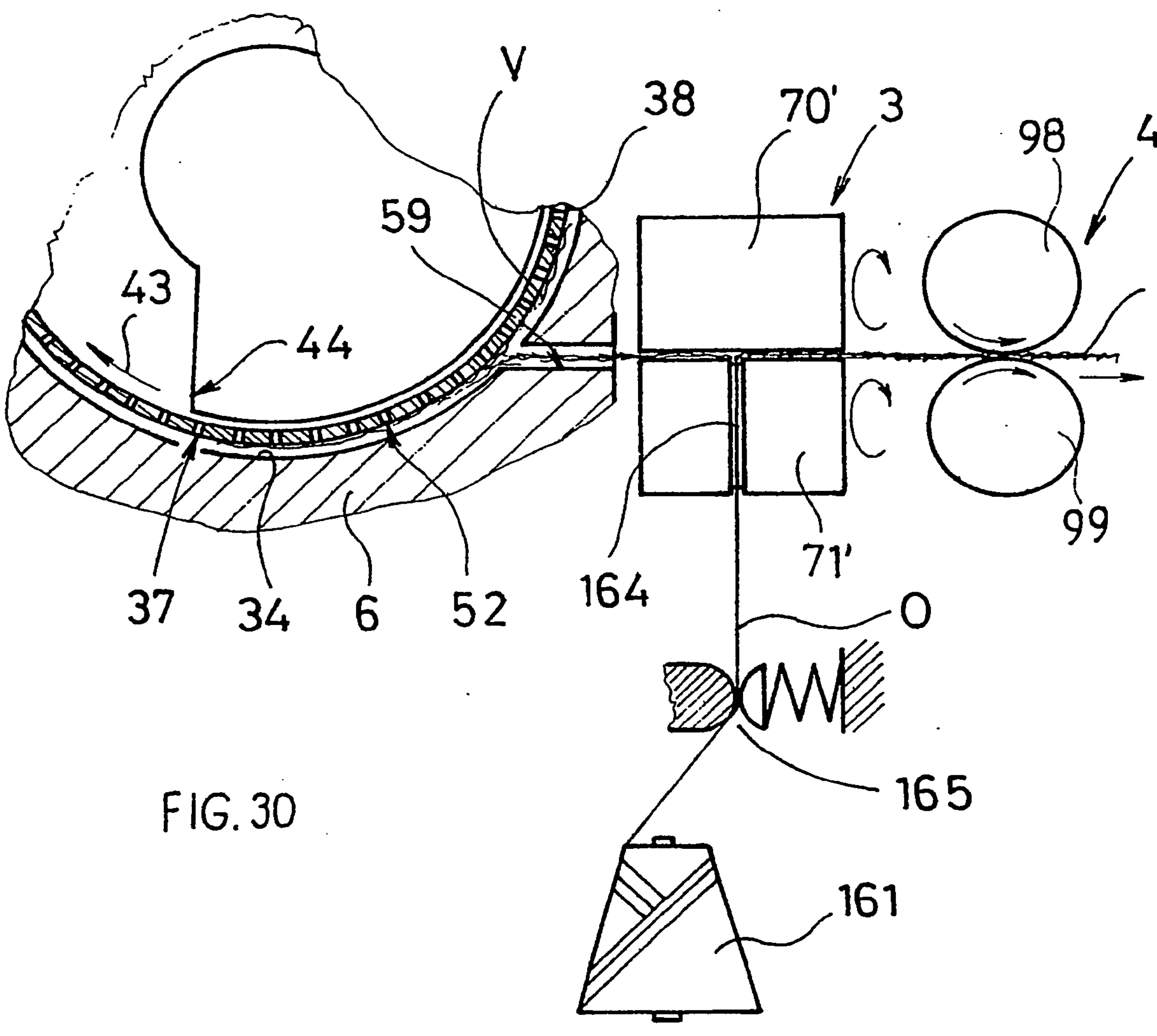
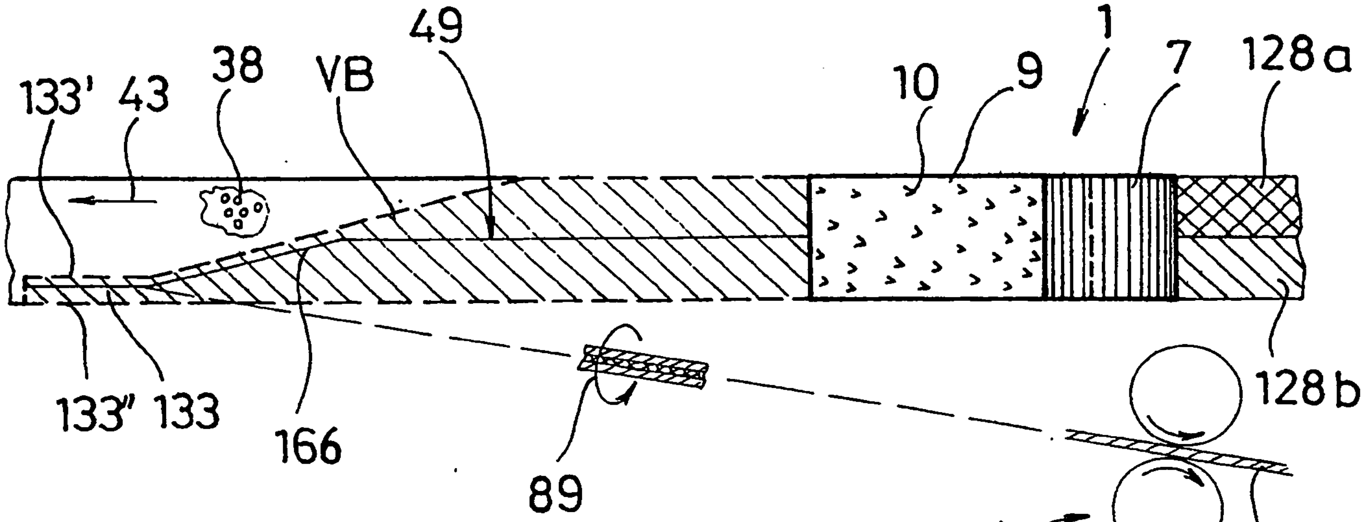


FIG. 30


133'
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49
10
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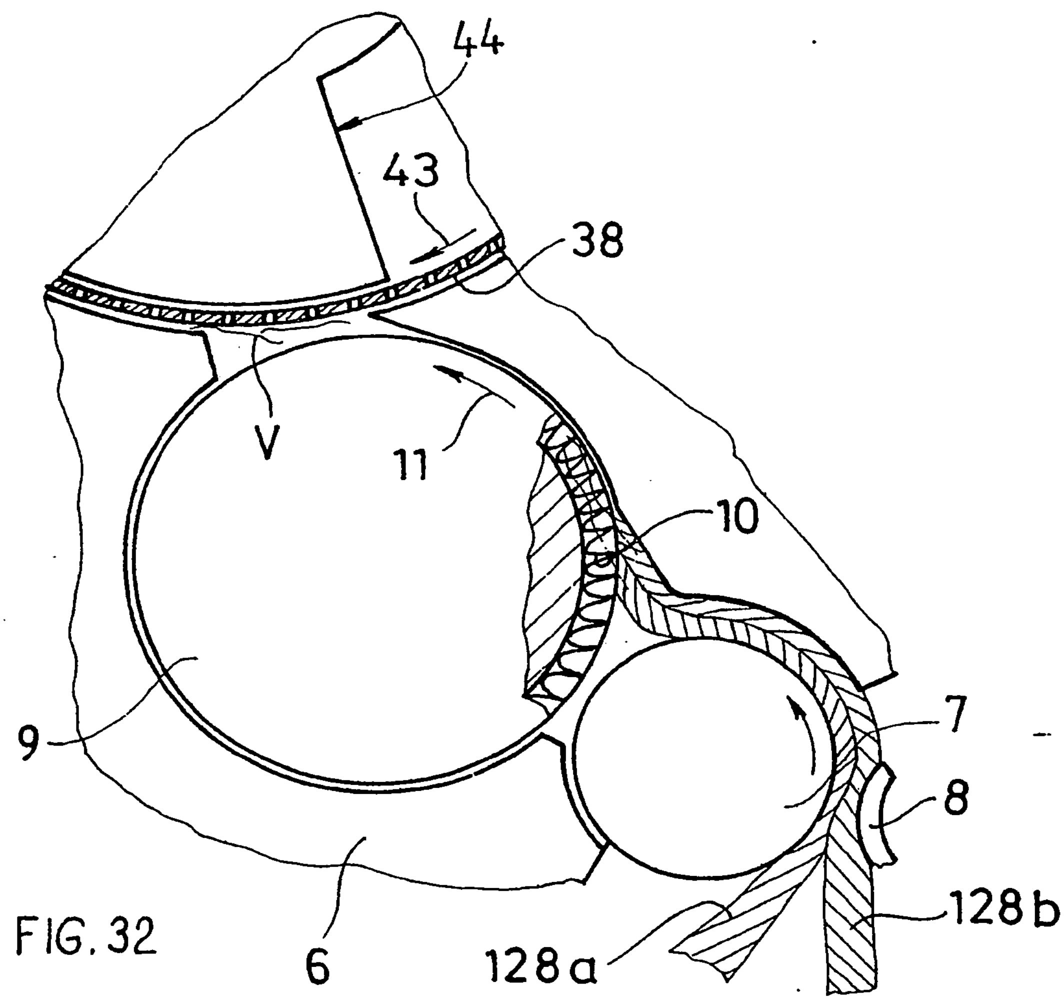
1
7
128a
133"
133
166
89
128b
4
PV

FIG. 31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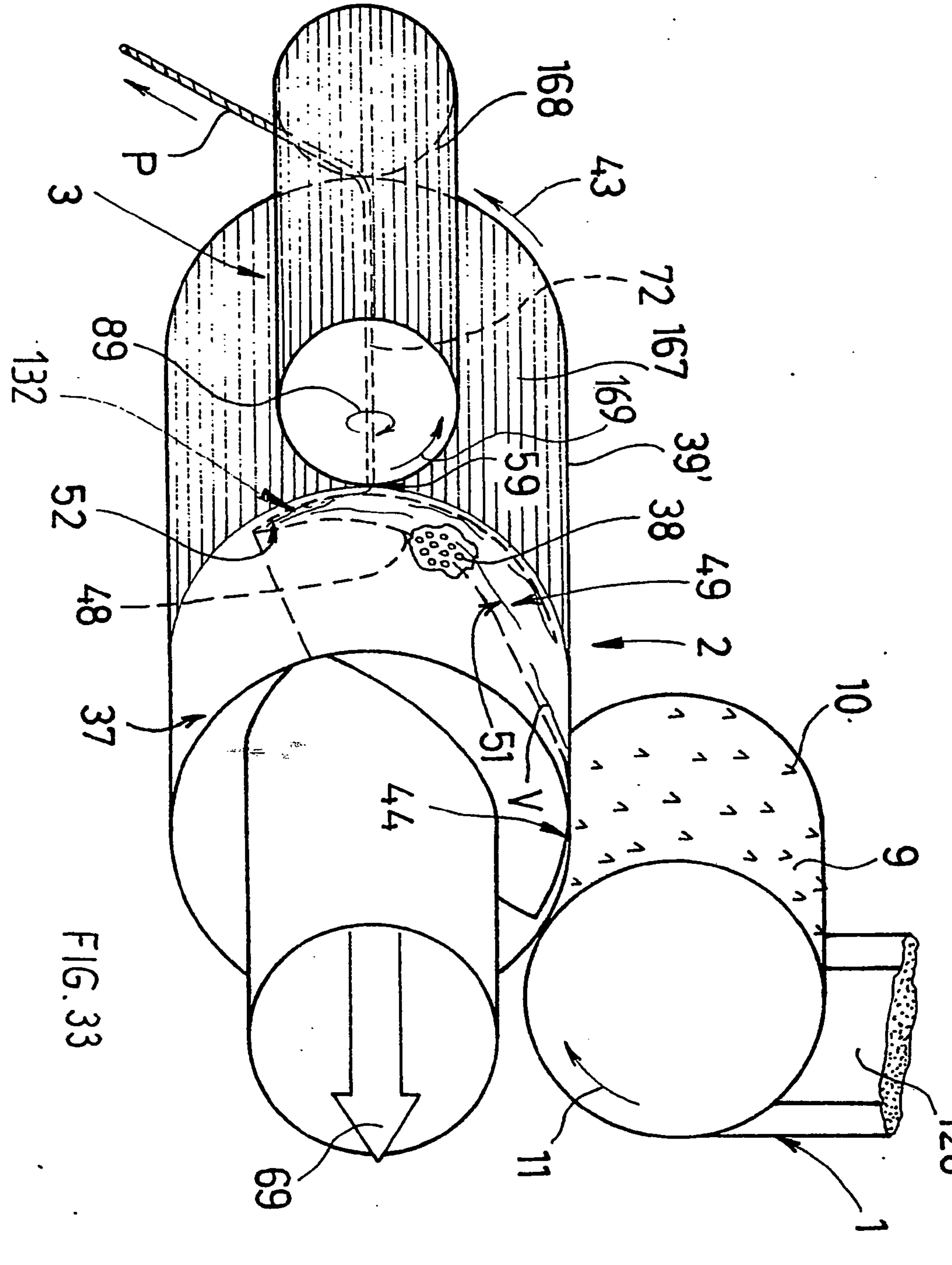
V
11
10
9
7
8
6
128a
128b

FIG. 32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43
P
3
72
167
89
169
132
39'
59
52
38
48
49
2
37
51
V
44
10
9
69
11
128
1

FIG. 33

SPECIFICATION

Open-end spinning process and apparatus

The invention relates, on the one hand, to an open-end spinning process, wherein discrete fibres are supplied onto a stationary suction field produced on a perforated surface of a revolving carrier, and wherein an elongate fibrous formation is formed from the supplied fibres on said suction field, said formation being withdrawn from the suction field and taken onto the open end of yarn given a true twist, and wound on a bobbin, and, on the other hand, to an apparatus for carrying out the process, comprising a fibre separating device followed by a fibre doubling device which is provided with a revolving carrier of a perforated surface and with a suction nozzle communicating with a subatmospheric pressure source producing a suction field on said perforated surface, further a fibre twisting device immediately following said fibre doubling device, a yarn withdrawing device and a yarn take-up device.

Among a plurality of known open-end spinning process types it is the rotor spinning process that is mostly availed of in practice. In this process, discrete fibres obtained by separating from a fibrous sliver are supplied through a supply duct onto an internal conical surface of a spinning rotor on which they are displaced by centrifugal force up to the widest portion of said surface, the so-called collecting groove. In this groove, fibres are continuously condensed to the form of a ribbon of oriented fibres which, by being taken onto an open-end of yarn, is withdrawn from said collecting groove and simultaneously twisted to yarn form within the yarn length section situated in the axis of rotation of said conical surface. However, this process is feasible only when twists retreat from said axial yarn length section to the collecting groove, said twists partly reinforcing the fibrous ribbon as being withdrawn. This reinforcement is necessary since the continuously withdrawn ribbon has to transmit an axial force arising by the rotation thereof, it being valid that each twist applied to the yarn corresponds to one revolution of the spinning rotor.

A drawback of the above otherwise progressive process consists in that any rise of yarn production necessarily requires the revolution rate of the spinning rotor together with the fibrous ribbon to be increased while the ribbon as being withdrawn has to withstand, due to increasing centrifugal forces, an ever growing axial force. Owing to such a physical barrier of the open-end spinning process productivity, the yarn cannot be provided with more than 100,000 twists per minute, even if all of the available technical means have been used for the improved twist retreat.

From the viewpoint of endeavour after the ever growing productivity of spinning systems, it is evidently more advantageous to apply such spinning processes wherein a condensed elongate fibrous formation, when being reinforced by twisting, is caused to rotate about an axis which is identical with its own axis. This essential principle has been brought into practice by various systems such as, for example, by a frictional open-end spinning system disclosed in the Austrian Patent Specification No. 333,631 or the British Patent Specification No. 2,042,599.

Although the productivity of the afore mentioned spinning systems is substantially higher than that of the rotor ones, the strength of the resulting yarn product is somewhat lower than that of yarns produced by the rotor spinning method, said strength being influenced by the character of the rotor spinning system.

According to another known system, when reinforcing the condensed fibrous longitudinal formation produced by its rotation about an axis substantially identical with its own axis, the condensing process is separated from the twisting one while the two processes are effected by separate means (see Japanese Patent Specification No. 38-19,625).

The open-end spinning process and the apparatus for carrying out the same according to the above Japanese Patent Specification referred to above in the first paragraph of the present specification consist in that discrete fibres are supplied from a separating device onto a suction field defined on a perforated surface of a revolving cylindrical carrier through a duct the mouth of which is in close but contactless relation to said perforated surface. The length orientation of the duct which is substantially identical with that of the fibres supplied, substantially corresponds to the direction of generatrix of said perforated surface. The suction field is defined on the perforated surface by a suction nozzle arranged in the interior of the thin-walled revolving cylindrical carrier and communicating with a subatmospheric pressure source. Adjacent one of edges of the suction field is the mouth of the supply duct, and the second edge is followed by a twisting device.

Due to the effect of the suction field manifesting itself by suction in the supply duct, fibres are conveyed through said duct until they adhere to and thereafter are fixed on the perforated surface. At the end of the suction field, the fibres are stripped off the perforated surface by a stripping blade and are condensed to an elongate fibrous formation which is then twisted by the twisting device to yarn being withdrawn and continuously wound on a bobbin.

In spite of some doubtless advantages, however, the system has certain drawbacks which negatively influence the internal yarn structure and consequently some physico-mechanical characteristics of yarn, particularly its strength.

It is an object of the present invention to improve the open-end spinning system disclosed in the above mentioned Japanese Patent Specification so as to ensure such a fibre orientation in the elongate fibrous formation which is advantageous for twisting and which is substantially parallel to the direction of motion of said formation on the perforated surface, and to simultaneously expose the fibre ends to the action of migration forces before the subsequent separate reinforcement of said formation by twisting to yarn form takes place. The fulfilment of these conditions would make it possible to produce yarns possessing advantageous physico-mechanical parameters, especially strength, by a high productivity.

Thus the object of the invention is to provide, on the one hand, a method of manufacturing yarn which is

realisable by simple means, and, on the other hand, a structurally simple and operationally reliable apparatus for performing the method.

The conditions as hereinabove set forth are complied with, at least to a considerable extent, according to the present invention in that the elongate fibrous formation on the perforated surface, when passing through the region of the suction field, is shaped by force means to a fibrous fringe narrowing from its maximum width, when reaching the suction field, to a pointed portion which is taken onto the open end of yarn withdrawn from the perforated surface in counter-direction to its motion.

Preferably, elongate fibrous formation is shaped to the fibrous fringe with the pointed portion in the form of a ribbon.

The elongate fibrous formation is shaped to the fibrous fringe on the perforated surface of the revolving carrier in the form of a cylinder, a frustum of a cone, a disc, or a strand of an endless belt.

The feature defining the fibrous fringe as being withdrawn from the perforated surface in counter-direction to its motion, is to be understood in a general meaning rather than exactly. The counter-directional withdrawal means that the fibrous fringe is withdrawn from the perforated surface at an acute angle in counter-direction to its motion, said acute angle, with the revolving carriers in the form of bodies of rotation, is defined by a tangent in the point of withdrawal of the fibrous fringe from the perforated surface and by the take-off direction. During the withdrawal of the fibrous fringe from the perforated surface provided on an endless belt, the acute angle is defined directly by the belt motion direction and the fibrous fringe withdrawal direction therefrom.

It is evident that the direction of withdrawal of the twisted fibrous fringe from the perforated surface passes through the end of pointed portion of said fringe on the perforated surface.

On the perforated surface of the cylindrical revolving carrier, the elongate fibrous formation is shaped to the fibrous fringe symmetrically, or asymmetrically to the central peripheral circle of the cylinder.

From the viewpoint of the final yarn structure it is advantageous that the elongate fibrous formation is shaped to the fibrous fringe with a pointed portion in the form of a ribbon the length of which corresponds at least to the mean staple length of fibres to be processed.

In case of the cylindrical revolving carrier the ribbon is oriented either symmetrically to the central peripheral circle of the cylinder, or adjacent one of the edges of the perforated surface. The same possibilities are with the revolving carrier in the endless belt form. In this case the ribbon is oriented symmetrically to the longitudinal belt axis.

With revolving carriers in the frusto-conical form and in the form of a disc it is preferable to apply a ribbon orientation adjacent the maximum circumference of the perforated surface.

The elongate fibrous formation is shaped on the perforated surface in the fibrous fringe by pneumatical means, and particularly either by the shape of the suction field, or by a combination of the suction field shape and an air flow directed to the surface of the fibrous fringe being shaped at least from one edge of the perforated surface transversely to its movement direction.

It is also possible to shape the elongate fibrous formation to the fibrous fringe by the suction field of unlimited shape and by air flows directed to the surface of the fibrous fringe being shaped, from the edges of the perforated surface transversely to its movement direction.

The air flows act on the elongate fibrous formation within a section preferably corresponding to the length of the narrowing fibrous fringe portion.

In another embodiment, the elongate fibrous formation is shaped to the fibrous fringe by the shape of the suction field and additionally by centrifugal force which acts on the fibres deposited on the revolving carrier in the form of a frustum of a cone, or a disc.

The elongate fibrous formation is condensed on the perforated surface by force means so that lateral distances between fibres decrease. The condensing process is realised in that fibres are caused to move toward one another on the perforated surface transversely to its motion. By condensing the elongate fibrous formation the fibre density on the perforated surface on which the fibres are deposited, is modified.

The structure of the fibrous fringe is characterised in that in any cross-section thereof, i.e. perpendicularly to the direction of its motion on the perforated surface, there exists a number of fibres which is smaller than the number of fibres in any cross-section of the final yarn produced by twisting the fibrous formation. The number of fibres in the fibrous fringe does not vary within broad limits, the fibres being oriented in this fibrous formation lengthwise to the direction of its motion together with the perforated surface.

The suction field is supplied with a flow of individualised fibres taken by a support of the suction field off the surface of the fibre opening cylinder of the fibre separating device, said cylinder being either adjacent to, or spaced apart from the revolving carrier and connected with it via connecting duct.

In the two above cases fibres are taken off the surface of the opening cylinder at a speed which corresponds to or is higher than the peripheral speed of said cylinder.

From the viewpoint of structure formation of the fibrous fringe on the suction field it is advantageous that the flow of individualised fibres is three dimensionally narrowing when passing through the connecting duct.

The process of the invention allows also multi-component yarns such as core yarns, wrapped yarns, or combined yarns to be manufactured. In the process of manufacturing a core yarn, at least one core yarn component to be twisted together with the yarn being produced, is supplied to the pointed portion of the fibrous fringe at a speed which either corresponds to or is different from the speed of the perforated surface motion.

The process of manufacturing a wrapped yarn consists in that into the yarn twisting region there is supplied at least one wrapping thread component which is twisted together with the yarn being produced to form a wrapped yarn.

In the process according to the invention it is also

possible to produce blended yarns wherein individual fibrous components are used in a desired ratio and in a desired structural arrangement in the yarn.

In this case, the fibre separating device is supplied with two or more fibrous slivers distinguishing from one another in type, titre, or colour, or the fibre opening cylinder is supplied with sectional fibrous slivers from fibre supply devices arranged about the periphery of said cylinder.

The fundamental structure of yarn produced in the spinning unit according to the invention has the so-called monotonous twist character. The essential character approaches rather to that of ring spun yarns whereas, with regard to the mass non-uniformity and the number of faults, the yarn has a markedly better quality. Consequently, also the appearance of such yarns is very calm. A substantial advantage over the rotor spun yarn is the absence of fibre crimps as well as a higher strength whereby the scope of practical applications of these yarns is extended.

By a very simple measure, i.e. by raising, or reducing the revolution rate of the twisting device, it is possible to produce either a hard-twisted yarn, or, on the other hand, a loosely twisted, soft or voluminous yarn, respectivley. To this purpose, any other technical or technological parameters of the spinning unit need not be adjusted.

A considerable advantage can be also seen in an easy reversibility of twist direction, since the Z-twist or S-twist is not determined but by the direction of rotation of the twisitng device. The choice of the twist direction is, for example, only the matter of changing phases of the driving electric motor. This, of course, makes it possible to produce, for instance, at one side of a two-sided machine the S-twisted yarn, and at the other side thereof the Z-twisted yarn, which offers in turn a possibility of better twisitng such yarns together.

The spinning apparatus is suitable to be used for producing yarns of cotton fibres, synthetic fibres of cotton type, or blend yarns.

However, the application of this spinning system to the production of yarn of wool and wool-like synthetic fibres is not excluded, provided the perforated surface is preceded by a separating device appropriately adjusted and dimensioned for this purpose. In such an adapted apparatus it will then be possible to produce also very coarse yarns.

A substantial advantage of the system of the present invention consists also in the possibility of processing contaminated and low-grade raw materials into first-quality yarns, due to an effective separation of impurities in the condensing step.

The apparatus for carrying out the process according to the invention, comprising a fibre separating device followed by a fibre doubling device which is provided with a revolving carrier of a perforated surface and with a suction nozzle communicating with a subatmospheric pressure source producing a suction field on said perforated surface, further a fibre twisting device immediately following said fibre doubling device, a yarn withdrawing device and a yarn take-up device, is characterised according to the invention in that the revolving carrier of the perforated surface is associated, on the one hand, with means for shaping an elongate fibrous formation on the suction field to a fibrous fringe narrowing from its maximum width in the region of fibre supply onto the suction field into a pointed portion, and, on the other hand, with a guide for withdrawing the twisted yarn from the suction field substantially in counter-direction to the motion of the perforated surface.

The yarn guide is preferably arranged, with regard to the suction field, for tangential withdrawal of twisted yarn from said field.

In an advantageous embodiment, the guide is in the form of a take-off duct for withdrawing yarn from the suction field, or is constituted immediately by the inlet of the fibre twisting device.

Preferably, the revolving carrier is associated with a fibre opening cylinder arranged in a close but contactless relation to the perforated surface in the beginning region of the suction field, the direction of rotation of the opening cylinder being opposite to the direction of motion of the perforated surface in the region of said close arrangement.

The revolving carrier can be embodied by a cylinder, a frustum of a cone, a disc, or an endless belt.

In the basic embodiment, the means for shaping the elongate fibrous formation is the suction field narrowing in the direction of motion of the perforated surface. The suction field is produced on the perforated surface by a shaped intake port of a suction nozzle adjacent the inner side of the perforated surface.

The suction field merges from its basic portion, which corresponds at the most to the active width of the fibre opening cylinder, into a narrowing portion ended by a final portion the width of which is substantially smaller than the width of the basic portion of the suction field. The final portion can be formed by a strip the length of which corresponds at least to the mean staple length of fibres to be processed.

In the symmetrical arrangement of the suction field, the narrowing portion thereof is constituted by a tongue, or a tongue and a strip. In the asymmetrical arrangement, the narrowing portion has the form of a wedge merging into the strip situated adjacent one of edges of the cylinder forming the revolving carrier of the perforated surface.

In one of the embodiments of the invention, the cylinder is mounted for rotation in a recess of a stationary housing, said recess encircling by its side wall close but contactless the perforated surface and communicating through a connecting duct with another recess housing the rotatable fibre opening cylinder, said recess merging into the take-off duct for yarn, the mouth of which is followed by the fibre twisting device, the narrowest portion between the perforated surface and the inner wall of said yarn take-off duct being situated in the region of the final portion of the suction field. The connecting duct is defined by a fly-off edge and a separating edge. The two recesses and the connecting duct are frontally masked by a cover of the housing to form a functional space separated from the ambient atmosphere.

According to one of the preferred embodiments on the cover of the housing a baffle is provided, which engages into the cavity of the revolving carrier in the form of the cylinder, and produces the suction field on the perforated surface.

In an embodiment, the shaping means comprise, on the one hand, the suction field narrowing in the direction of motion of the perforated surface, and, on the other hand, a lower annular suction gap provided in the bottom of the recess of the housing in which the revolving carrier in the form of the cylinder is mounted for rotation, and/or an upper annular suction gap provided in the cover of said housing, at least one of said annular suction gaps the curvilinear length of which substantially correspond to the length of the narrowing portion of the suction field, being situated on a lateral extension of the perforated surface.

In another embodiment, the shaping means comprise, on the one hand, the suction field of unlimited shape, and, on the other hand, the lower annular suction gap provided in the bottom of the recess of the housing in which the revolving carrier in the form of the cylinder is mounted for rotation, and the upper annular suction gap provided in the cover of said housing, the two annular suction gaps the curvilinear lengths of which substantially correspond to the length of the narrowing portion of the suction field, being situated on a lateral extension of the perforated surface.

In case the opening cylinder is adjacent to the perforated surface, its peripheral speed corresponds at most to the speed motion of said surface.

An advantageous feature of the apparatus according to the invention consists in that the length of the connecting duct is selected so that the opening cylinder is spaced apart from the revolving carrier at a distance which is larger than the mean staple length of fibres to be processed.

The height of the connecting duct is preferably narrowing in the direction of fibrous material flow.

The jacket of the cylinder forming the revolving carrier of the perforated surface can have a slightly concave profile in the form of an arch, or a wedge, or can be provided with a guide channel about its central peripheral circle.

The apparatus designed for manufacturing core yarns is characterised in that into the side wall of the recess, in the region of the narrowing portion of the suction field, at least one guiding duct opens for supplying a core component.

The apparatus for manufacturing wrapped yarns which comprises a pair of co-directionally rotating twisting cylinders is characterised in that in one of said cylinders a peripheral groove is provided for a wrapping thread component.

In a preferable embodiment, the take-off duct merges at the side opposite to its mouth into a coaxial suction duct communicating via regulation flap with a through suction conduit. The suction duct has a larger through-flow cross-section than the take-off duct.

From the viewpoint of optimum pneumatic conditions in the yarn forming region, a suction hole preferably opens into the side wall of the recess, immediately upstream of the fly-off edge.

According to an alternative variant of the apparatus, the revolving carrier is formed by a ring having the perforated surface provided on its inner side, the opening cylinder of the separating device arranged inside said ring, being arranged adjacent said inner side, and wherein adjacent the outer side of the perforated surface the suction tube is arranged.

Another variant consists in that the fibre twisting device comprises, on the one hand, a frictional surface of the revolving carrier, which surface merges into the perforated surface, and, on the other hand, a friction cylinder in a close but contactless relation to said frictional surface, the direction of rotation of said cylinder corresponding to that of the perforated surface.

Some preferred embodiments of the apparatus according to the present invention will be hereinafter described with reference to the accompanying schematic drawings, wherein:-

Figure 1 shows a partly sectional top view of the apparatus comprising a fibre separating device, a fibre doubling device and a fibre twisting device;

Figure 2 is a sectional view taken along the line II-II in Figure 1;

Figure 3 is a front view of the apparatus;

Figures 4 through *6* show alternative embodiments of a suction field on a perforated surface developed into a plane;

Figures 7 and *8* are alternative embodiments of the perforated surface of a revolving carrier, in axial sectional views;

Figures 9 through *11* show alternative embodiments of the fibre twisting device in perspective views;

Figure 12 is a perspective general view of a spinning unit;

Figure 13 shows a detail view of the cylindrical revolving carrier, partially in section;

Figure 14 is a sectional view taken along the line XIV-XIV in Figure 13;

Figure 15 is a detail view of a baffle developed into a plane;

Figures 16 through *18* are views showing alternative embodiments of means for producing a suction field on the perforated surface of the cylindrical revolving carrier, in a partial axial section through said cylinder;

Figure 19 is a detail view of another embodiment of the baffle developed into a plane;

Figure 20 is a detail view of a connecting duct between the opening cylinder and the revolving carrier, in a partial section along a plane perpendicular to the axis of said cylinder;

Figure 21 is a fragmentary top view of the mouth of an impurity withdrawing duct after removing a cover;

Figure 22 is a sectional view taken along the line XXII-XXII in Figure 21;

Figure 23 is a sectional view taken along the line XXIII-XXIII in Figure 21;

Figure 24 is a detail view of an embodiment of the fibre doubling device;

Figures 25 and *26* are detail views of other embodiments of the fibre doubling device;

Figure 27 shows a partial sectional view of another embodiment of the doubling device;

Figure 28 is a detail view of the perforated surface shown in Figure 27, projected into a plane;

Figure 29 shows a detail top view of the fibre doubling device adapted for producing core yarns;

Figure 30 is a detail sectional top view of the fibre doubling device for producing wrapped yarns;

Figure 31 shows the distribution of fibrous components in the fibre doubling device for producing multi-component yarns;

Figure 32 is a detail top view of the fibre doubling device for producing multi-component yarns; and

Figure 33 is a perspective view of an embodiment of the fibre separating and doubling devices.

The apparatus shown in Figures 1, 2 and 3 comprises a fibre separating device *1*, a fibre doubling device *2*, a fibre twisting device *3*, a yarn withdrawing device *4* and a yarn take-up device *5*.

The fibre separating, doubling and twisting devices *1*, *2* and *3*, respectively, are received in a housing *6* attached to the machine frame by not shown means. The fibre separating device *1* comprises, on the one hand, a feed roller *7* positively driven in the direction of arrow and co-operating with a shoe *8* forced thereonto by not shown means, and, on the other hand, a fibre opening cylinder *9* provided with teeth *10* and mounted for rotation in the direction of arrow *11*. The opening cylinder *9* is arranged in a recess *12* merging into another recess *13* in which the feed roller *7* is disposed. The separating device *1* and the doubling device *2* are masked by a cover *14* secured to the housing *6* by screws *15*.

As can be seen in Figure 3, the feed roller *7* has a shaft *16* which is coupled via an electromagnetic coupling *17* with a shaft *18*. A spiral gear *19* carried by said shaft *18* is in mesh with a not shown spiral gear on a through shaft *20* mounted in bearings in the machine frame *21* and driven from a first electric motor *25* through a gear train *22* via a gearbox *23* as well as through another gear train *24*.

The fibre opening cylinder *9* has a shaft *26* carrying a friction disc *27* meshing with a central driving belt *28* which couples a guide pulley *29* mounted for rotation on the machine frame with a pulley *30* of a second electric motor *31* (Figures 2 and 3).

The recess *12* which houses the fibre opening cylinder *9* has a side wall *32* which defines together with the surface of said cylinder the fibre transport way and is important for the operation of the fibre separating device *1* (Figure 1).

The recess *12* in the housing *6* communicates via a connecting duct *33* with a recess *34* housing the fibre doubling device *2*. The transition between said recess *12* and said connecting duct *33* is defined by a fly-off edge *35* and a separating edge *36*.

The fibre doubling device *2* (Figure 1) arranged in the housing *6* comprises a revolving carrier *37* of a perforated surface *38* which carrier, in the primary embodiment of the apparatus, is embodied by a thin-walled cylinder *39* having a perforation *40* and being in a close, but contactless relation to the opening cylinder *9*.

The cylinder *39* of which upper front wall is opened, is supported by a shaft *41* (Figures 2, 3, 7 and 8) which is rotatable in the housing *6* and meshes by means of a friction disc *42* with the central driving belt *28*. The direction of rotation of the cylinder *39* (arrow 43) is opposite to the direction of rotation of the opening cylinder *9*, said friction disc *42* being disposed at the opposite sides of the central driving belt *28* relative to the friction disc *27* for driving the fibre opening cylinder *9*. In operation, the peripheral speed of the perforated surface *38* has to be at least the same as the peripheral speed of the teeth *10* of the opening cylinder *9*.

In the cavity of the cylinder *39* there is arranged a stationary suction nozzle *44* communicating via piping *45* with a through suction conduit *46* connected to the suction branch of a fan *47* (Figure 3). By its intake port *48* the suction nozzle *44* is in a close, but contactless relation to the inner side of the perforated surface *38* of the cylinder *39*.

The shape of the intake port *48* defines at the outer side of the perforated surface *38* a stable suction field *49* which constitutes one of means for shaping an elongate fibrous formation into a fibrous fringe. The suction field *49* can have various configurations.

Figures 4, 5 and 6 shown by dashed lines typical forms of the suction field *49* on a developed plane of portion of the perforated surface *38* the direction of motion of which is indicated by arrow *43*. The profile of the connecting duct *33* projected onto the developed plane is indicated by dot-and-dash lines. The suction field *49* is substantially defined by a basic portion *50* merging in the direction of arrow *43* downstream of the region of the connecting duct *33* into a narrowing portion *51* ended by a final portion *52*. The width *L* of the basic portion *50* is at most the same as the width L_1 of the active surface of the fibre opening cylinder *9* (Figure 2) while the width L_2 of the final portion *52* is a fraction of the width *L*. As shown in Figures 5 and 6, the final portion has the form of a strip *53* the length L_3 of which is at least the same as the mean staple length of fibres to be processed.

From its basic portion *50*, the suction field *49* narrows either symmetrically (Figures 4, 5) or asymmetrically (Figure 6) to a central peripheral circle *54* of the cylinder *39* (see dot-and-dash lines in Figures 4 through 6). As can be seen in Figure 4, the suction field *49* narrows from its basic portion *50* into the form of a tongue *55* with the final portion *52* in the form of a dull point while according to Figure 5 it narrows into the form of an isosceles triangle *56* merging into the final portion *52* in the form of the strip *53*. Figure 6 shows the suction field *49* which narrows from its basic portion *50* into the form of a wedge *57* which merges into the strip *53* disposed at one, in the exemplary embodiment lower edge of the perforated surface *38*. The beginning of the suction field *49* is defined by an edge *58* opposite the fly-off edge *35* of the connecting duct *33* (Figure 1).

Between the doubling device *2* and the twisting device *3* a guide *59* (Figure 1) is provided for withdrawing yarn *P* from the suction field *49* substantially in counter-direction to the motion of the perforated surface *38*. The guide *59* is embodied in this case by a take-off duct *60* tangentially connected to the recess *34* housing the cylinder *39*. The mouth of said yarn take-off duct *60* is disposed in front of the inlet of yarn *P* into the twisting device *3*.

The narrowest portion *61* of the take-off duct *60* defined by the active surface of the cylinder *39* and the inner side of said duct *60* is situated in the region of the final portion *52* of the suction field *49*. At the opposite side, the take-off duct *60* merges into the suction duct *62* communicating via a regulation flap *63* with the through suction conduit *46*. The inner diameter of the take-off duct *60* is smaller than the inner diameter of the suction duct *62*.

The side wall of the recess *34* in the housing *6*, the

bottom *65* of said recess *34* and the preferably transparent cover *14* of the housing *6* (Figure 1) define an operational space out of which, in the region of the suction field *49*, air is sucked through the suction nozzle *44* over the perforated surface *38*. This operational space communicates with the ambient atmoshpere, on the one hand, via the connecting duct *33* communicating through the separating device *1* with the ambient atmoshpere, and, on the other hand, via the suction duct *62*, or another vent hole such as a suction hole *66* (see dashed lines in Figure 1), the mouth of which is preferably situated upstream of the fly-off edge *35*.

The perforated surface *38* is constituted either by the surface of the cylinder *39* (Figure 1), or by another adequate surface having, for instance, a concave profile. As shown in Figure 7, such a concave profile has the configuration of a wedge *67*.

In Figure 8 the cylindrical surface of the cylinder *39* is provided in the region of a not shown central peripheral circle with a guide channel *68*. The direction of motion of air sucked off through the suction nozzle *44* is indicated by arrow *69* (Figures 7, 8).

The above described embodiments of the cylinder *39* make it possible to achieve a better guiding of yarn when beint spliced with fibres in the region of the final portion *52*. The yarn end rotated by the twisting device *3* can be better centered in the channel, or on the top of concave profile onto the fibres as being adjoined so that axial oscillation of yarn end which, in extreme values, may even cause fibres to fly-off, is avoided.

The twisting device *3* can be constituted by any suitable well-known means. Some preferred embodiments thereof are shown in Figures 1, 2, 3, 9, 10 and 11.

As can be seen in Figures 1 through 3, the twisting device *3* comprises two twisting cylinders *70, 71* which are provided on the surface with an appropriate frictional, e.g. rubber coating and which are in a close, but contactless relation to each other so that they form a wedge-like gap *72* in which said surfaces move, in operation, in counter-direction indicated by arrows. Shafts *73, 74* of said twisting cylinders *70* and *71*, respectively, (Figure 1) are mounted for rotation in not shown bearings provided in the housing *6*. The prolonged shaft *73* of the cylinder *70* terminates in a friction roll *75* which is adapted to mesh with a through driving belt *76* by which a pulley *77* is coupled with a pulley *78* of a third electric motor *79*. The direction of motion of said through driving belt *76* is indicated by arrow *80*.

The shaft *73* is associated with an electromagnet coupling *81*. The twisting cylinder *71* is driven by a friction disc *82* mounted for rotation in the housing *6* and being in a frictional engagement with the other cylinder *70* (Figure 2). The position of the twisting cylinders *70, 71* is selected so that an imaginary axis comprising the top of the wedge-like gap *72* substantially passes through the not shown axis of the take-off duct *60*. In the opposite extension of axis of the wedge-like gap *72* there is provided a guide eye *83* which is adjusted by well-known means (not shown) in the direction of double-headed arrow *84* (Figure 2).

Another embodiment of the fibre twisting device *3* shown in Figure 9 consists of a pair of partly shown endless friction belts *85, 86* which are driven by not shown driving means in such a manner that their parallel strands are moved in counter-direction to each other as indicated by arrows *87* and *88*. Alternatively, the parallel strands can form parts of one and the same endless friction belt. The yarn *P* twisting direction is indicated by arrow *89*.

Figure 10 shows another embodiment of the twisting device *3* which is constituted by a small-diameter twisting spindle *90* driven by well-known not shown means in the direction of arrow *89*. The torque is transmitted to yarn *P* by a spring-loaded flap *91* contacting the inner wall *92* of cavity of the twisting spindle *90*.

Still another embodiment of the fibre twisting device *3* shown in Figure 11 consists of a whirl chamber *93* which is supplied with pressure air (arrow *95*) through a tangential duct *94* producing in its interior a potential air vortex designed for twisting yarn in the direction of arrow *89*. Air is then ejected out of the chamber *93* through side vent holes *96* and *97*.

The yarn withdrawing device *4* (Figure 3) comprises a usual pair of rollers such as, in this embodiment, a through roller *98* and a pressure roller *99*. One of the ends of said through roller *98* which is mounted for rotation in bearings provided in the machine frame 21, carries a pulley *100* coupled via belt *101* with another pulley *102* on the shaft of the gearbox *23*.

The pressure roller *99* is mounted for rotation on an arm of a bush *103* resiliently attached to a stationary carrying rod 104. The yarn withdrawing device *4* is preferably provided with a guide eye *105* mounted for periodical reciprocation within the range of width of the pressure roller *99* in the direction of double-headed arrow *106*. This motion is derived from any well-known not shown mechanism.

The yarn take-up device *5* comprises a yarn distributing eye *107* provided on a partly shown through rod *108* mounted for periodical reciprocation in the machine frame *21* in the direction of double-headed arrow *109*, the motion being derived from not shown driving means, further a partly shown tiltable bobbin holder *110* carrying a tube *111* of a bobbin *112*, and a through drive roller *113* mounted for rotation in the machine frame *21* and coupled through a pulley *114*, a belt *115* and another pulley *116* with the through roller *98*. By modifying the size of the pulleys *114* and *116* the tension of yarn *P* as being withdrawn can be adjusted.

Between the twisting device *3* and the withdrawing device *4* (Figure 3) there is situated a sensor *117* for monitoring the presence of yarn *P* the operation of which is based, for example, on the indication of axial tension of yarn engaging a tongue *118* of said sensor *117*. The latter is connected through line *119* with a control unit *120*. This control unit *120* is connected via line *121* with the electromagnetic coupling *17* interposed within the drive of the feed roller 7, via line *122* (Figures 1, 3) with the electromagnetic coupling *81* for controlling the drive of the twisting device *3*, viz. in this embodiment the friction disc *82* (Figures 2, 3), via line *123* with a mechanism *124* for controlling the motion of the bobbin holder *110*, and via line *125* with well-known means *126* for indicating the motion

of the bobbin *112*. The control unit *120* is designed for providing, by well-known, not specified means, for time-program control of active mechanisms of the spinning unit on the basis of impulses from the sensor *117*.

Figure 11 shows an embodiment wherein the electromagnetic coupling *81* is replaced by an electromagnetic valve *127* for controlling the pressure air supply to the whirl chamber *93*.

The spinning unit operates as follows:

A fibrous sliver *128* stored in a sliver can *129* (Figures 1 and 3) is supplied by the feed roller 7 and the co-operating shoe *8* to the teeth *10* of the opening cylinder *9* where fibres are combed out of said sliver, accelerated on their transport way and further individualised. The fibre accelerating process takes place up to the fly-off edge *35*. In this region, the discrete fibres *V* are being already doffed from the clothing *10* of the opening cylinder *9*, due to the action of centrifugal forces produced by the motion of fibres around the substantially circular path and simultaneously by the action of vacuum forces of the suction field *49* of the revolving carrier *37*, said vacuum forces being active within the region of the connecting duct *33*, and supplied to the co-directionally moving perforated surface *38*. The direction of transport of fibres *V* is oriented substantially in the direction of tangent to the perforated surface *38*, due to the action of centrifugal forces depending upon the weight of the fibres supplied and to the action of tangential acceleration of fibres on the periphery of the opening cylinder *9*.

The process of combing fibres out of the fibrous sliver *128* is a random process depending on the distribution of fibre ends in the sliver as well as on the course of instantaneous combing forces so that fibres are accelerated on the periphery of the opening cylinder *9* on various paths and with various mutual shifts. As results from the foregoing, the fibres will be supplied to various regions of the perforated surface *38* on the basic portion *50* of the suction field *49* within the width *L* (Figures 4, 5 and 6).

Each fibre *V* supplied onto the rotating perforated surface *38* is fixed on said surface by the action of vacuum forces of the suction field *49*.

Hereinafter the process taking place on the suction field *49* shown in Figure 5 will be described. If the fibre is fixed in the central region of the basic portion *50*, it will advance together with the perforated surface *38* along the narrowing portion *51* and the final portion *52*. If, however, the fibre is fixed to the perforated surface *38* at any one of the edges of the basic portion *50*, the leading fibre end, when advancing together with the perforated surface *38* through the narrowing portion *51*, will leave said narrowing portion *51* so that it is not exposed to the vacuum effect any more. Due to the centrifugal force, the leading fibre end is being separated from the perforated surface *38* whereby the friction force between said surface and the surface of the released fibre end will decrease. However, the fibre is simultaneously exposed to a predominant side suction force at the edge of the narrowing portion *51*, so that this force will cause that the fibre end begins to deflect back to said narrowing portion *51* and, finally, to be displaced on the perforated surface *38*, during the rotary motion together with it, onto said narrowing portion *51*. Such an elementary displacement process hereinabove explained for the leading fibre end takes place also in case of every other fibre part so that the fibre, after covering the section of the perforated surface *38* corresponding to the region of the narrowing portion *51*, will be displaced in this region substantially into its central part the width of which corresponds to the width L_2 of the final portion *52*.

It is evident that the fibre distributed at random on the basic portion *50* and fixed by the vacuum effect on the perforated surface *38* are displaced from the narrowing portion *51*, due to the above described process, to the final portion *52* in which all the fibres are oriented lengthwise about the periphery of the perforated surface *38*. Since a very narrow region is concerned here, it may be simply assumed that the distribution of fibres in this region relative to its axis is quite uniform.

The final portion *52* or strip *53*, respectively, has at least such a length L_3 to ensure that a predominant part of fibres oriented therein is situated in said final portion. This condition will be met also in the case that at least the mean fibre staple length L_{str} corresponds to the length L_3.

At the end of the final portion *52* where fibres are no more exposed to the vacuum effect of the suction field, a situation would necessarily occur that the fibres in an oriented form will fly-off, depending on the chosen draft, either with a small overlap, or one after the other, away from the perforated surface *38* in a substantially tangential direction. In such a fly-off process there would be at first released the leading fibre end which would assume, due to mechanical forces outweighing the fibre rigidity, the position in the direction of resultant of these forces, i.e. a radial force, viz. centrifugal force, and a tangential force, viz. force of inertia. A vacuum effect at the end of the final portion *52* trying to return the fibre back against the motion of the perforated surface, is overcome by a higher energy of fibre inertia.

If, just in the region upstream of the final portion *52*, the yarn end to be spun-in which adheres to said portion by the effect of vacuum forces produced therein and which simultaneously rotates by the effect of twists propagating from the twisting device *3*, approaches fibres present in this region, the fibres are caught by said rotating yarn end. The time course of this process consists in that the caught fibre is exposed to a braking effect resulting in an intense axial force in the fibre which tensions every fibre section, whereby the fibre migration process during the spinning-in is positively influenced. As to the yarn structure it is practically irrelevant whether the fibre will be caught by the yarn at its leading end, or at its tail end. In both cases the braking effect, which is the result of compensation of a difference between the peripheral speed of the perforated surface *38* corresponding to the fibre velocity, and the take-off speed of yarn *P*, is very high whereby fibres are straightened in axial direction of the yarn and consequently a very good internal yarn structure is obtained.

A considerable advantage of the spinning process wherein the fibre, after having been separated from the

sliver, is continuously controlled by force means until being caught by the yarn, results from the above explanation. The absence of this factor with the other open-end spinning systems impairs the internal yarn structure, which results particularly in a reduction of yarn strength.

A co-directional effect of centrifugal forces and vacuum forces while doffing the fibres *V* from the teeth *10* of the opening cylinder *9*, makes it possible to substantially reduce the peripheral speed of said teeth *10*. This evidently results in a considerable technological advantage consisting in a milder process of combing fibres out of the sliver and in a significant reduction of fibre shortening. In this way, consequently, the useful fibre length in the yarn increases and the yarn strength parameters will rise.

Another advantage consists in that by controlling the vacuum force conditions, it is made possible to influence the doffing force with various fibrous materials to be processed and to individualise various fibre types by a single type of teeth of the opening cylinder. This is impossible with the apparatuses operating without the above described vacuum effect so that it is necessary to use with the rotor spinning machines different teeth types for various fibrous materials.

The spinning process is very stable, since the system operates with a lower axial force in the yarn than, for instance, the open-end rotor spinning system. Also, the separation of fibrous material from impurities that may cause spinning failures, is very intensive.

Another advantage consists in that the spinning unit is apt to process even very contaminated fibrous raw materials, since hard impurities and dust particles which have not been sucked in through holes of the perforated surface, are hurled off the perforated surface at the end of the final portion of the suction field and exhausted through the suction duct *62* into the through suction conduit *46* where they can be caught on filters. The separation of impurities from the fibre surface may be promoted, for example, by introducing air into the system through the suction hole *66* (Figure 1). In this case the fibres are exposed to various pneumatic forces which result from different pneumatic resistances of fibres and impurities so that fibres and impurities are deposited on the perforated surface *38* onto different areas.

The spinning-in process is effected as follows:

From the bobbin *112* on the tilted out bobbin holder *110*, an appropriate yarn length is unwound and its end is introduced, outside the withdrawing device *4*, through the eye *83* and the wedge-like gap *72* up to the mouth of the take-off duct *60*. Due to the vacuum effect in said duct *60*, the yarn end is conveyed via the narrowest portion *61* into the suction duct *62*. The magnitude of vacuum effect in said suction duct *62* is adjusted by the regulation flap *63*, depending on the yarn type and, particularly, on the flexibility thereof. The introduced yarn length will tangentially adhere to the perforated surface *38* upstream of the final portion *52* of the suction field *49*. Due to the effect of vacuum forces in the take-off duct *60* and, particularly, friction forces produced by the contact of yarn with the perforated surface *38*, the axial tension in yarn will rise whereby the tongue *118* of the sensor *117* is displaced into the operative position, and the spinning unit is ready for the spinning-in process. In this phase, the electromagnetic couplings *17* and *81* are disengaged.

The command for the engagement of the electromagnetic couplings *17* and *81* is released by the control unit *120* at the impulse of the device *126*. As soon as the bobbin *112* begins to rotate, the command is given at first to the electromagnetic coupling *17* of the feed roller and then, after a delay, to the electromagnetic coupling *81*. While the yarn is successively withdrawn, due to the take-off motion, from the take-off duct *60*, the fibres are combed out of the sliver, accelerated, deposited and fixed on the perforated surface *38* as well as displaced to the final portion *52*. As the first fibres have been displaced to the final portion *52* of the suction field *49*, the yarn end which is already outside the suction duct *62*, adheres to the perforated surface *38*. Since this moment which is relevant for engaging the electromagnetic coupling *81*, the twisting cylinders *70*, *71* begin to twist the yarn, and the twists which propagate up to yarn end adhering to the perforated surface *38* upstream of the end of the final portion *52*, begin to rotate the yarn open-end. The yarn end, while being withdrawn and rotated, takes on the fibres *V* which are twisted in the next region into yarn *P*. The process takes place continuously, and the yarn *P* led over the tongue *118*, is introduced by hand to between the rollers *98*, *99* of the withdrawing device *4* as well as into the guide eye *105* and the distributing eye *107*. By the co-operation of said eye *107* and the rotation of the drive roll *113*, the yarn *P* is wound onto the bobbin *112*.

In case of a thread breakage a signal is released by the sensor *117* to the control unit *120* which by disengaging the electromagnetic coupling *17* stops the fibre feed to the opening cylinder *9*, and stops the twisting device *3* by disengaging the electromagnetic coupling *81*. The other elements, i.e. opening cylinder *9* and take-off device *4*, remain in operation.

Fibres combed out of the sliver after stopping the supply device, together with yarn remnants after the breakage, fly successively away through the suction duct *62* and are caught on a filter in the through suction conduit *46*. The spinning unit is ready now for the spinning-in process as hereinabove referred to.

Since the individual steps necessary for preparing the spinning unit for the spinning-in process are relatively simple, the process can be preferably automated by using known means.

Figure 12 shows the spinning unit in a perspective view wherein, for the sake of simplicity and better understanding, means for mounting and driving the active elements of the unit are omitted.

The spinning unit consists of the fibre separating device *1*, the fibre doubling device *2*, the fibre twisting device *3*, the yarn withdrawing device *4* and the take-up device (not shown here).

The separating device *1* comprises the feed roller *7*, the shoe *8* provided with a condenser *130*, and the opening cylinder *9*. The doubling device *2* comprises the revolving carrier *37* in the form of the cylinder *39* with the perforated surface *38*, and the suction nozzle *44* which communicates via piping *45* with a subatmospheric source and the intake port *48* of which

defines on the perforated surface *38* the suction field *49* of the configuration shown in Figure 5.

The feed roller *7* conveys the fibrous sliver *128* to the opening cylinder *9*, the discrete fibres doffed from the teeth *10* of the opening cylinder *9* by the effect of the suction field *49* being deposited onto the rotating perforated surface *38* to form a fibrous formation which is shaped, when passing through the area of the suction field *49*, into the fibrous fringe VB having a narrowing portion *131* of a tongue form which merges into a pointed portion *132* constituted by a ribbon *133*. The fringe VB is withdrawn from the final portion of the suction field *49* in counter-direction to the motion of the perforated surface *38*, taken by said pointed portion *132* or ribbon *133* onto the open end of yarn *P*, and given in this counter-direction, in the direction of arrow *89*, a true twist formed during the passage of yarn through the twisting device *3*. Yarn *P* withdrawn by the withdrawing device *4* is then wound in the take-up device (not shown) onto a bobbin. In this embodiment, the guide *59* is constituted by the take-off duct *60*.

In case of the suction field *49* of the configuration shown in Figure 4, wherein its final portion *52* does not merge into the strip *53*, it is the obtuse point of the pointed portion *132* of fibrous fringe VB that will be immediately taken onto the rotating yarn open end.

In case of the suction field *49* shown in Figure 6, the elongate fibrous formation is shaped on said field into the narrowing wedge-like portion *131* merging into the pointed portion *132* constituted by the ribbon *133*. The fibrous fringe VB will be then taken onto the rotating yarn open end immediately by said ribbon *133*.

The process of shaping or displacing the fibres to the fibrous fringe as the result of the effect of lateral suction force at the edge of the narrowing portion *51* of the suction field *49* (Figure 4 through 6) has been explained in the foregoing. This process causes the fibre end leaving this region, to begin to be deflected back to said region so that, apart from the rotary fibre motion on the perforated surface *38*, also a sideward displacement thereof occurs. The sideward vacuum force is produced by an air flow sucked-in in the narrowing portion *51* of the suction field *49*. In the production of said air flow characterised by a certain speed *c*, particularly the perforation *40* of the perforated surface *38* at the edge of the narrowing portion *51*, takes part. Since the speed *c* is determined by the through flow of air through said lateral holes only, its value is not too high so that either the sideward vacuum force Q proportional to said speed *c* is not too high. This results in that the fibre displacement takes place slower and, consequently, on a relatively large area of periphery of the revolving perforated surface *38*. Somewhat better conditions exist with the rotating perforated surface *38* wherein the sideward vacuum force Q overcomes minor sideward friction forces, due to a compensation of normal suction forces by the centrifugal force *F*.

The shaping of fibres on the narrowing portion *51* of the suction field *49* can be supported by sideward air flows which constitute a concentrate flowing of air sucked in through all of the holes along the respective generatrix. By this measure it is made possible to raise the air flow about the fibre being displaced, or the air speed *c* influencing the resulting sideward vacuum force *Q*, respectively.

Figures 13 through 15 show an embodiment of the fibre doubling device *2* adapted for forming the fibrous fringe by an interaction of shaping means.

Figure 13 shows the arrangement of the revolving carrier *37* in the form of cylinder *39* in the housing *6*, and Figure 14 shows a radial sectional view of the perforated surface *38* taken along the line XIV-XIV in Figure 13, led through the narrowing portion *51* of the suction field *49*.

From the cover *14* there extends, perpendicularly into the cavity of the cylinder *39*, a baffle *134* which is in the close, but contactless relation to the inner wall of the cylinder. The baffle *134* is shown, for the sake of clarity, in Figure 15 in the developed form, wherein the width L_x of a cutout *135* through which the plane of section XIV-XIV passes, is indicated. The cutout *135* of the baffle *134* defines the suction field *49* on the perforated surface *38*.

Into the recess *34* of the housing *6* two suction gaps open, viz. an upper annular suction gap *137* provided in the cover *14*, and a lower annular suction gap *138* provided in the bottom *65* of said recess *34*. The two gaps which communicate with the ambient atmosphere lie on the level of the perforated surface *38* and their curvilinear lengths substantially correspond to the peripheral length of the narrowing portion *51* of the suction field *49*.

Due to a pressure gradient, air flows (arrows 139, 140) are produced (Figure 14).

The maximum width of the baffle *134* corresponds to the width *L* of the basic portion *50* of the suction field *49* while the converging edges *135a* of the cutout *135* define on the suction field *49* the narrowing portion *51*, and the parallel edges *135b* define the final portion *52* of the suction field *49*.

In this case the intake port of the shaped suction nozzle as shown in Figure 1 is omitted in the cavity of the revolving carrier *37*, and air is sucked off this cavity through the overall cross-section of the cylinder *39* over the cutout *135* of the baffle *134*.

The supplied fibres are deposited by the effect of the suction field *49* onto the basic portion *50* within the width *L* whereupon they are sidewardly shaped or displaced by the effect of air flow (arrows *139, 140*) into the fibrous fringe, and by the shape of the final portion *52* of the suction field *49* into the strip wherein they are fixed already in a condensed form. In this case the fibrous formation is shaped into the fibrous fringe symmetrically with regard to the not shown central peripheral circle of the cylinder *39*.

Thus it is evident that the sideward vacuum force *Q* the fibres are exposed to, is the most effective one. To ensure the fibre displacement, a relatively short area of periphery of the perforated surface *38* and, consequently, a shorter suction field *49* are sufficient. It is preferable to choose the curvilinear length of the annular suction gaps *137, 138* oriented in the direction of periphery of the perforated surface *38* so as to correspond at least to 1.2 of the mean staple length of fibres to be processed. The width of said gaps can be very narrow. Substantially, it may correspond to the diameter of perforations *40* of the perforated surface *38*.

Figure 16 shows an axial sectional view of the

perforated surface *38* taken through the narrowing portion *51* of the suction field *49*. The intake port *48* of the suction nozzle *44* defines the width L_y of the suction field *49* in a section plane. The arrangement of the suction gaps *137*, *138* corresponds to the embodiment shown in Figures 13 and 14.

Figure 17 shows a variant of the suction field *49* in an axial section through the perforated surface *38*. In this case the suction field *49* is provided about the entire periphery of the perforated surface *38* so that air is sucked off on this entire surface.

Also in this embodiment, the upper annular suction gap *137* and the lower annular suction gap *138* open into the recess *34* in the housing *6*, and suck in from the ambient atmosphere air flows (arrows *139*, *140*) by which fibres supplied onto the perforated surface *38* are shaped into the fibrous fringe. The effect of fibre displacement is higher in this case, due to higher sideward vacuum forces *Q* produced by the higher number of holes in the perforated surface *38*. Therefore also the curvilinear length of the suction gaps can be very short. This embodiment does not have on the perforated surface a locally defined suction field but the fibres, due to sideward air flows, are displaced from the entire width *L* into a narrow area on the perforated surface *38* where they are fixed by the vacuum effect. Although such a high fibre displacing force is desirable from the technological viewpoint, it is not preferable from the viewpoint of power consumption.

Figure 18 shows a variant of means for defining the suction field on the perforated surface *38*. In this embodiment, the baffle *134'* has an asymmetric configuration as partially shown in Figure 19 in developed state, wherein, for the sake of clarity, also the corresponding widths *L* L_z are shown. The recess 34 in the housing *6* communicates with the ambient atmosphere in the region of a sideward fibre displacement, i.e. in the region of the narrowing portion *51* of the suction field, through the upper annular suction gap *137* only.

The oblique edge *141* of the baffle *134'* defines on the suction field the narrowing point *51* while the horizontal edge *142* defines the final portion *52*. The fibres are exposed to a one-side displacing effect of the sideward air flow (arrow *139*) whereupon they are fixed onto the strip of the suction field at the lower edge of the perforated surface *38*. In this case the elongate fibrous formation is shaped into the fibrous fringe asymmetrically with regard to the central peripheral circle of the cylindrical perforated surface.

It, however, is to be noted that there exists also some other variants which make it possible to obtain a desirable fibre displacing effect on the perforated surface, produced either by the vacuum effect of the suction field itself, or in an interaction with a shaped suction nozzle and/or a baffle.

As shown in Figure 1, the opening cylinder *9* is in a close relation to the perforated surface *38* in the connecting duct *33*, which means that the fibres, on their way between the two elements, are controlled by the contact with at least one of them. Nevertheless, according to another feasible embodiment of the invention, as shown in Figures 13 and 20, the opening cylinder *9* is spaced apart from the perforated surface *38*. In this case the connecting duct *33* is constituted by a supply duct *143* oriented in tangential direction to the surface of the opening cylinder *9* and to the surface of the cylinder *39*. The depth of the supply duct *143* corresponds to the width of the opening cylinder *9* as well as to the width of the perforated surface *38*. The width *B* of the supply duct *143* is either constant along its entire length thereof (Figure 20), or is continuously narrowing from the opening cylinder *9* to the revolving carrier *37* (not shown).

The yarn *P* as being built, is twisted in the direction of arrow *89* and withdrawn in counter-direction to the motion of the perforated surface *38* (see arrow *43*) over the pin *144* through the take-off duct *60*. The pin is preferably made of an abrasion-resistant material such as sintered corundum.

According to a preferred embodiment, the side wall of the recess *34* is spaced apart in certain regions from the perforated surface *38*. Figure 21 shows a recess *145* (see also Figure 22) provided in the region corresponding to the basic portion *50* and to the narrowing portion *51* of the suction field *49*. It is also advantageous that the recess *145* is continuously narrowing until in a region corresponding to the beginning of the final portion *52* of the suction field *49*, it returns to the initial close relation to said perforated surface *38*.

It is also suitable to provide a groove *147* in the side wall of the recess *34* (Figure 23), and particularly in the region of the final portion *52* of the suction field *49*. The groove *147* merges by its front edge via pin *144* into the take-off duct *60* for yarn *P* while by its rear edge it merges into an impurity ejecting duct *148* provided in the housing *6* and communicating via not shown means with the through suction conduit *46* (Figure 1).

A characteristic feature of said groove *147* consists in that its curvilinear length is larger than the mean staple length of fibres to be processed. For this reason the take-off duct *60* is peripherally shifted up to the end region of the final portion *52*. The impurity ejecting duct *148* can serve for both impurity withdrawal and the spinning-in process. The purpose of such an arrangement is to provide above the fibres in the final portion *52* a free space for rotation of the end of yarn *P* while fibres are simultaneously doubled or accumulated into this end. The rotation of yarn end in the space of the groove *147* has its advantage in a lower resistance of yarn to the propagation of twists from the twisting device *3* to the open end whereby losses on twists are reduced. Another advantage consists in that the impurities which have not yet been released, are separated from the fibres during the yarn end rotation, and carried away through the space of said groove *147* into the ejecting duct *148* outside the yarn being produced.

In the production of yarn, the fibrous fringe is withdrawn from the perforated surface *38* in counter-direction to the motion of the latter and taken by its narrowest pointed portion, i.e. ribbon, onto the rotating yarn open end. Under the term "in counter-direction" it is to be understood that said fibrous formation is withdrawn from the perforated surface at an acute angle, preferably tangentially, to the final portion 52 of the suction field *49* (Figure 1) over the guide *59*. In

case that the twisting device *3* is not immediately constituted by said guide *59*; the location of said device *3* relative to the final portion *52* is immaterial but the direction of fringe withdrawal from said portion *52* is important. As shown in Figure 21, the yarn as being produced is withdrawn from the suction field over the pin *144* which in this case embodies the guide *59*, and is given a twist in the direction of arrow *89*.

As can be seen in Figure 21, yarn is withdrawn from the final portion *52* of the suction field *49* at a very small angle while the angle of yarn withdrawal downstream of this pin *144* is substantially larger.

The revolving carrier *37* of the perforated surface *38* may be embodied also otherwise than by the thin-walled cylinder *39* as shown in Figure 1.

Figure 24 shows the opening cylinder *9* the clothing *10* of which is in close relation to the revolving carrier *37* in the form of a frustum of a cone *150* having the perforated surface *38*.

In the interior of said frustum of a cone *150* there is disposed a suction nozzle (not shown) producing on the perforated surface *38* the suction field *49* (see dash-lines) having the basic portion *50* the width *L* of which corresponds to that of the active surface of the opening cylinder *9*, further the narrowing portion *51* and the final portion *52* which is provided in the invisible portion of the cone *150* along the edge of its base.

The withdrawn yarn *P* passes through the not shown twisting device wherein it is given a twist in the direction of arrow *89*.

The axis *151* of rotation of the opening cylinder *9* and the axis *152* of the frustum of a cone *150* are concurrent. For the sake of simplification, the drive and the mounting of said elements are not shown in Figure 24.

The second embodiment of the revolving carrier *37* is shown in Figure 25. In this case the perforated surface *38* is provided on the revolving carrier *37* in the form of a thin-walled disc *153*. Adjacent said disc *153* there is arranged the opening cylinder *9* the axis *151* of rotation of which is perpendicular to the axis *154* of rotation of the disc *153*. A shaped intake port of a not shown suction nozzle which is arranged in a close but contactless relation to the lower surface of the disc *153*, produces on the upper surface thereof the suction field *49* (dash-lines) comprising the basic portion *50*, the narrowing portion *51* and the final portion *52*. The direction of rotation of the disc *153* is indicated by arrow *43*. The mounting and drive means of the disc *153* as well as those of the opening cylinder *9* are not described or shown in detail since they are immaterial for understanding this variant.

The third embodiment of the revolving carrier is shown in Figure 26. The carrier *37* is here in the form of an endless belt *155* having the perforated surface *38* moving in the direction of arrow *43*. The opening cylinder *9* is arranged adjacent a strand *156* of said belt *155*. Adjacent the inner surface of the endless belt *155* there is arranged the not shown shaped intake port of a suction nozzle so as to produce on the perforated surface *38* the suction field *49* (dash-lines). For the sake of clarity, the mounting and driving means of the endless belt *155* and that of the opening cylinder *9* are omitted in Figure 26.

The fourth variant of the revolving carrier is shown in Figures 27 and 28. The carrier is embodied by a thin-walled ring *157* with the perforated surface *38*. Adjacent the inner surface of said ring *157* there is arranged the opening cylinder *9* of the fibre separating device *1* which is stationary in the ring cavity. The drive and mounting of the ring *157* and the separating device *1* which are not described or shown in detail, are effected by using known, not shown means.

Adjacent the outer side of the perforated surface *38* there is arranged the suction nozzle *44* in the form of a segment *158* which communicates with a not shown subatmospheric pressure source. The shaped intake port *48* of the suction nozzle *44* produces on the perforated surface *38* the suction field *49* as can be seen in dash-lines in Figure 28 which shows a part of the perforated surface *38* developed into plane.

Yarn *P* (Figures 24 through 27) withdrawn from the final portion *52* of the suction field *49* over the not shown guide of the respective embodiment in counter-direction to the motion of the perforated surface *38*, is twisted in a not shown twisting device in the direction of arrow *89*.

The fourth embodiment (Figures 27, 28) distinguishes from the other ones in that the elongate fibrous formation is shaped on the perforated surface *38* provided on the inner surface of the ring *157* and withdrawn over a not shown guide such as, for instance, the inlet of the twisting device.

All of the embodiments shown in Figures 24 through 28 have the following common features:

- Due to the effect of clothing *10* of the opening cylinder *9* rotating in the direction of arrow *11*, fibres of the sliver *128* are individualised and deposited in the form of discrete fibres *V* onto the perforated surface *38* on which they are carried in the direction of arrow *43*.
- During this common motion of fibres *V* and the perforated surface *38*, fibres are displaced or shaped transversely to the direction of their motion so that they are successively condensed during their motion through the narrowing portion *51* and the final portion *52* of the suction field *49*.

Differences between the above variants consist above all in the systems of forces the fibres are exposed to while being displaced in the suction field *49*.

In all of the embodiments as hereinabove set forth and shown in Figures 24 through 28, the sideward vacuum force *Q* can be evidently produced by means of the above described sideward flows, the resultant of forces provoking here a transverse or sideward displacement of fibres.

In the spinning unit of the invention it is possible to manufacture, by using simple additional means, multi-component yarns such as, particularly, core yarns, wrapped yarns, or combined yarns. Figure 29 shows a spinning unit equipped with means for producing a core yarn *PJ*.

In this embodiment, a guiding duct *159* opens into the recess *34* in the housing *6* downstream of the final portion *52* of the suction field *49*, in the direction of rotation of the perforated surface *38* (arrow *43*). A pin *160* of an abrasion-resistant material such as sintered

corundum arranged in the housing *6* in the region where the guiding duct *159* opens into the recess *34*, engages into said duct *159*.

A core thread component *J* such as synthetic monofil, spun yarn, filament yarn, tape or the like, withdrawn from a supply package *161*, is supplied by the yarn withdrawing device *4* through the guiding duct *159* over the pin *160* in counter-direction to the motion of the perforated surface *38* to the final portion *52* of the suction field *49*. By the action of a not shown twisting device, a yarn being produced is twisted together with said core component *J* in the direction of arrow *89* whereby fibres in said portion *52* are caught and caused to wrap about the running core component *J*. The latter, upstream of the twisting device, is given a temporary false twist which, however, partly gets lost in the core yarn take-off region. The losses of false twists in the core are advantageously availed of, with some of core materials such as spun yarn, for improving the contacts between the core and the superficial fibrous layer whereby a positionally stable structure of the final core yarn product is obtained.

In case it is desirable, for some technological reasons, to effect the partial elimination of false twists already upstream of the twisting device, it is possible to withdraw the core component *J* from the supply package *161* sidewards or, moreover, to set this package by known, not shown means in rotation in the direction of arrow *162* corresponding to that of twisting the core yarn *PJ*.

The core component can be brought into the spinning process by the core yarn take-off, without tension, braked with a prestress, but also with overfeed, i.e. at a higher speed than the core yarn take-off speed, whereby various fancy yarn structures can be obtained. In case of overfeed there are produced loops outstanding from the yarn body which, within a predominant part of its length, has a core structure characterised by a core wrapped with fibres.

If using an elastic core component such as a rubber thread, it is possible to produce rubber threads wrapped with fibres which are suitable for a plurality of specialised purposes of textile industry. In this case the rubber thread is supplied preferably with a very small overfeed, e.g. by means of feed rollers *163* indicated by dash-lines in Figure 29.

Figure 29 shows also another embodiment of the apparatus for manufacturing core yarn comprising two core thread components *J*, *J'* which are unwound from supply packages *161*, *161'*, respectively. The component *J'* is supplied to the final portion *52* of the suction field *49* through another guiding duct *159'* over a pin *160'*. In this way it is possible to obtain a specific structure with an absolutely reliable stable wrapping layer, such core yarns being suitable to be used for technical purposes such as particularly for the manufacture of cord fabrics.

Figure 30 shows an embodiment of the spinning unit designed for manufacturing wrapped yarn *PO*. The twisting device *3* consists of a pair of cylinders *70'*, *71'*, the latter being provided with a peripheral groove *164* into which a wrapping thread component *O* is supplied. This component which is of the same or different colour relative to the staple material, is unwound either immediately from the supply package *161*, or over a brake *165*. To obtain a loop effect in the yarn, the wrapping thread component *O* can be supplied with an overfeed so as to pass through the peripheral groove *164* alternately in contact with the surface of groove bottom, and loosely.

To meet specific requirements, it is also possible to produce combined yarns, i.e. alternately core yarns and wrapped yarns, by using substantially the same means therefor.

In the spinning unit of the invention it is also possible to manufacture multi-component yarn structures. Into this group there can be comprised yarns wherein, for example, one fibre component is of cotton and forms the superficial yarn portion whereas another fibre component of polyester forms the yarn interior. When manufacturing such a yarn type, two slivers of different fibrous materials are supplied either in parallel to the feed roller, or separately by a pair of feeding devices associated with the opening cylinder and conveying said slivers to it.

In the first case (see Figure 31), two sectional fibrous slivers *128a*, *128b* are simultaneously supplied by the feed roller *7* to the opening cylinder *9* of the fibre separating device *1*. The two fibrous slivers carried separately on the surface of the opening cylinder *9*, are conveyed onto the partly shown perforated surface *38* moving in the direction of arrow *43*.

By an appropriate choice of shape of the suction field it is possible to form on said perforated surface *38* some desired structures of multi-component yarns. Particularly suitable for this purpose is the shape of suction field *49* shown in Figure 6. On this field there is shaped, due to the above described effect of vacuum forces, the elongate fibrous formation having a basic width identical with the width *L* of the basic portion *50* of the suction field, into the fibrous fringe *VB* having a wedge-like portion *166* merging into the ribbon *133*, the two fibrous components being conveyed up to the ribbon separately. In an upper narrower portion *133'* of the ribbon *133* there are accumulated fibres from the sectional sliver *128a* while in a lower broader portion *133''* thereof there are accumulated fibres from the sectional fibrous sliver *128b*. By twisting the ribbon *133* in the direction of arrow *89* and by withdrawing it from the perforated surface *38* in counter-direction to the motion of the latter (see arrow 43), a multi-component yarn *PV* is formed.

The embodiments as hereinabove set forth make it possible to produce yarns as well as woven and knitted fabrics therefrom having quite unorthodox characteristics. Thus, for instance, there are advantageous cotton/polypropylene staple fibre combinations wherein the superficial polypropylene component is apt to conduct humidity into the internal cotton component which is capable of binding it. Apart from this, the multi-component structure enables also low-grade materials to be processed; while the superficial yarn layer is of a material of higher quality, the core can be made of low-grade one.

Figure 32 shows the manufacture of multi-component yarns from two sectional fibrous slivers *128a*, *128b* which are supplied to the feed roller *7* of

the separating device *1* in parallel one above the other.

Figure 33 is a perspective view showing the fibre doubling device *2* combined with a variant of the twisting device *3*. In this case the revolving carrier *37* is embodied by the cylinder *39'* which is wider than the cylinder *39* shown in Figure 12. The right-hand half of the surface of the cylinder *39'* is constituted by the perforated surface *38* whereas the left-hand one by a frictional surface *167*. Into the cavity of the cylinder *39'* the suction nozzle *44* engages, the shaped intake port of which defines on the perforated surface *38* the suction field *49* produced by the not shown basic portion, the narrowing portion *51* and the final portion *52*. The frictional surface *167* is in a close, but contactless relation to a friction cylinder *168* the longitudinal axis of which (not shown) is parallel to the longitudinal axis (not shown) of the cylinder *39'*. The direction of rotation of the friction cylinder *168* (arrow *169*) corresponds to the direction of rotation of the cylinder *39'* (arrow *43*). In this case the frictional surface *167* of the cylinder *39'* forms together with the friction cylinder *168* the twisting device *3* while the inlet into said device constitutes simultaneously the guide *59* for withdrawing the yarn *P* produced on the suction field *49*.

CLAIMS

1. An open-end spinning process, wherein discrete fibres are supplied onto a stationary suction field produced on a perforated surface of a revolving carrier, and wherein an elongate fibrous formation is formed from the supplied fibres on said suction field, said formation being withdrawn from the suction field and taken onto the open end of yarn given a true twist and wound on a bobbin, the elongate fibrous formation on the perforated surface, when passing through the region of the suction field, being shaped by force means to a fibrous fringe narrowing from its maximum width, when reaching the suction field, to a pointed portion which is taken onto the open end of yarn withdrawn from the perforated surface in counter-direction to its motion.

2. A process according to claim 1, wherein the elongate fibrous formation is shaped to the fibrous fringe with the pointed portion in the form of a ribbon.

3. A process according to claim 1, wherein the elongate fibrous formation is shaped to the fibrous fringe on the perforated surface of the revolving carrier in the form of a cylinder.

4. A process according to claim 3, wherein the elongate fibrous formation is shaped to the fibrous fringe symmetrically to the central peripheral circle of the revolving cylindrical carrier.

5. A process according to claim 3, wherein the elongate fibrous formation is shaped to the fibrous fringe asymmetrically to the central peripheral circle of the revolving cylindrical carrier.

6. A process according to claim 1, wherein the elongate fibrous formation is shaped to the fibrous fringe on the perforated surface of the revolving carrier, in the form of a frustum of a cone.

7. A process according to claim 1, wherein the elongate fibrous formation is shaped to the fibrous fringe on the perforated surface of a revolving carrier in the form of a disc.

8. A process according to claim 1, wherein the elongate fibrous formation is shaped to the fibrous fringe on the perforated surface in the form of strand of an endless belt.

9. A process according to claim 2 and at least one of claims 3, 6, 7, 8, wherein the elongate fibrous formation is shaped to the fibrous fringe with the pointed portion in the form of a ribbon situated at one of the edges of the perforated surface.

10. A process according to claim 2, wherein the elongate fibrous formation is shaped to the fibrous fringe with the pointed portion in the form of a ribbon the length of which corresponds to the mean staple length of fibres to be processed.

11. A process according to claim 1, wherein the elongate fibrous formation is shaped to the fibrous fringe on the perforated surface by pneumatic means.

12. A process according to claim 11, wherein the elongate fibrous formation is shaped to the fibrous fringe by the form of the suction field.

13. A process according to claim 12, wherein the elongate fibrous formation is shaped to the fibrous fringe additionally by an air flow directed to the surface of the fibrous fringe being produced, from at least one edge of the perforated surface transversely to the direction of its motion.

14. A process according to claim 11, wherein the elongate fibrous formation is shaped to the fibrous fringe by the suction field of unlimited shape and by air flows directed to the surface of the fibrous fringe being produced, from edges of the perforated surface transversely to the direction of its motion.

15. A process according to claims 13 and 14, wherein the air flows act on the elongate fibrous formation within a section corresponding to the length of the narrowing fibrous fringe portion.

16. A process according to claim 12, wherein the elongate fibrous formation is shaped to the fibrous fringe by the form of suction field and additionally by centrifugal force.

17. A process according to claim 1, wherein onto the pointed portion of the fibrous fringe there is supplied at least one core thread component being twisted together with the yarn being produced to form a core yarn.

18. A process according to claim 17, wherein to the pointed portion of the fibrous fringe there is supplied at least one core thread component at a speed corresponding to the speed of the perforated surface motion.

19. A process according to claim 17, wherein onto the pointed portion of the fibrous fringe there is supplied at least one core thread component at a speed different from the speed of the perforated surface motion.

20. A process according to claim 1, wherein to the yarn twisting region there is supplied at least one wrapping thread component which is twisted together with the yarn being produced to form a wrapped yarn.

21. A process according to claim 1, wherein the suction field is supplied with a flow of discrete fibres taken by the action of said suction field off the surface of the fibre opening cylinder which is arranged adjacent the revolving carrier.

22. A process according to claim 1, wherein onto the suction field there is supplied a flow of discrete fibres taken by the action of said suction field off the surface of the fibre opening cylinder which is spaced apart from the revolving carrier and connected with it via a connecting duct.

23. A process according to claims 21 and 22, wherein fibres are taken off the surface of the opening cylinder at a speed corresponding to the peripheral speed of said cylinder.

24. A process according to claims 21 and 22, wherein fibres are taken off the surface of the opening cylinder at a speed which is higher than the peripheral speed of said cylinder.

25. A process according to claim 22, wherein the flow of individualised fibres is three-dimensionally narrowing when passing through the connecting duct.

26. An apparatus for carrying out the process according to claim 1, comprising a fibre separating device followed by a fibre doubling device which is provided with a revolving carrier of a perforated surface and with a suction nozzle communicating with a subatmospheric pressure source producing a suction field on said perforated surface, further a fibre twisting device immediately following said fibre doubling device, a yarn withdrawing device and a yarn take-up device, the revolving carrier of the perforated surface being associated, on the one hand, with means for shaping an elongate fibrous formation on the suction field to a fibrous fringe narrowing from its maximum width in the region of fibre supply onto the suction field into a pointed portion, and, on the other hand, with a guide for withdrawing the twisted yarn from the suction field substantially in counter-direction to the motion of the perforated surface.

27. An apparatus to claim 26, wherein the guide is arranged relative to the suction field for a tangential withdrawal of the twisted yarn from the suction field.

28. An apparatus according to claim 26, wherein the guide is a take-off duct for withdrawing yarn from the suction field.

29. An apparatus according to claim 26, wherein the guide is an inlet of the fibre twisting device.

30. An apparatus according to claim 26, wherein the revolving carrier is associated with a fibre opening cylinder arranged in a close but contactless relation to the perforated surface in the beginning region of the suction field, the direction of rotation of the opening cylinder being opposite to the direction of motion of the perforated surface in the region of said close arrangement.

31. An apparatus according to claim 26, wherein the revolving carrier is a cylinder.

32. An apparatus according to claim 26, wherein the revolving carrier is a frustum of a cone.

33. An apparatus according to claim 26, wherein the revolving carrier is a disc.

34. An apparatus according to claim 26, wherein the revolving carrier is an endless belt.

35. An apparatus according to claim 26, wherein the means for shaping the elongate fibrous formation is the suction field narrowing in the direction of motion of the perforated surface.

36. An apparatus according to claim 35, wherein the suction field is produced on the perforated surface by the shaped intake port of a suction nozzle adjacent the inner side of the perforated surface.

37. An apparatus according to claim 35, wherein the suction field merges from its basic portion, which corresponds at the most to the active width of the fibre opening cylinder, into a narrowing portion ended by a final portion the width of which is a fraction of the width of the basic portion of the suction field.

38. An apparatus according to claim 37, wherein the final portion is formed by a strip.

39. An apparatus according to claim 37, wherein the suction field merges from its basic portion into its final portion symmetrically relative to the central peripheral circle of the cylinder constituting the revolving carrier of the perforated surface.

40. An apparatus according to claim 37, wherein the suction field merges from its basic portion into its final portion asymmetrically relative to the central peripheral circle of the cylinder constituting the revolving carrier of the perforated surface.

41. An apparatus according to any one of claims 37 and 39, wherein the narrowing portion is formed by a tongue.

42. An apparatus according to claims 37 and 40, wherein the narrowing portion is formed by a wedge merging into the strip situated adjacent one of edges of the cylinder being the revolving carrier of the perforated surface.

43. An apparatus according to claim 38, wherein the length of the strip corresponds at least to the mean staple length of fibres to be processed.

44. An apparatus according to claim 31, wherein the cylinder is mounted for rotation in a recess of a stationary housing, said recess encircling by its side wall close but contactless the perforated surface and communicating through a connecting duct with another recess housing the rotatable fibre opening cylinder, said recess merging into the take-off duct for yarn, the mouth of which being followed by the fibre twisting device, the narrowest portion between the perforated surface and the inner wall of said yarn take-off duct being situated in the region of the final portion of the suction field.

45. An apparatus according to claim 44, wherein the two recesses and the connecting duct are frontally masked by a cover of the housing to form a functional space separated from the ambient atmosphere.

46. An apparatus according to claim 45, wherein on the cover of the housing a baffle is provided, which engages into the cavity of the revolving carrier in the form of the cylinder and defines the suction field on the perforated surface.

47. An apparatus according to claim 26, wherein the shaping means comprise, on the one hand, the suction field narrowing in the direction of motion of the perforated surface, and, on the other hand, a lower annular suction gap provided in the bottom of the recess of the housing in which the revolving carrier in the form of the cylinder is mounted for rotation, and/or an upper annular suction gap provided in the cover of said housing, at least one of said annular suction gaps the curvilinear length of which substantially correspond to the length of the narrowing portion of the suction field, being situated on lateral extension of the perforated surface.

48. An apparatus according to claim 26, wherein the shaping means comprise, on the one hand, the suction field of unlimited shape, and, on the other hand, the lower annular suction gap provided in the bottom of the recess of the housing in which the revolving carrier in the form of the cylinder is mounted for rotation, and the upper annular suction gap provided in the cover of said housing, the two annular suction gaps the curvilinear length of which substantially correspond to the lengths of the narrowing portion of the suction field, being situated on a lateral extension of the perforated surface.

49. An apparatus according to claim 30, wherein the peripheral speed of the opening cylinder corresponds at most to the speed of motion of the perforated surface.

50. An apparatus according to claim 44, wherein the length of the connecting duct is selected so that the opening cylinder is spaced apart from the revolving carrier at a distance which is larger than the mean staple length of fibre to be processed.

51. An apparatus according to the claim 50, wherein the width of the connecting duct is narrowing in the direction of fibrous material flow.

52. An apparatus according to claim 31, wherein the cylinder has a jacket of a concave profile.

53. An apparatus according to claim 52, wherein the concave profile is in the form of a wedge.

54. An apparatus according to claim 31, wherein the cylinder is provided with a guide channel about the central peripheral circle.

55. An apparatus according to claim 44, wherein into the side wall of the recess, in the region of the narrowing portion of the suction field, at least one guiding duct opens for supplying a core component.

56. An apparatus according to claim 26, comprising a pair of co-directionally rotating twisting cylinders, characterised in that in one of said twisting cylinders a peripheral groove is provided for a wrapping thread component.

57. An apparatus according to claim 44, wherein the take-off duct mergers at the side opposite to its mouth into a coaxial suction duct communicating via regulation flap with a through suction conduit.

58. An apparatus according to claim 57, wherein the suction duct has a larger through flow cross-section than the take-off duct.

59. An apparatus according to claim 44, wherein into the side wall of the recess, immediately upstream of the fly-off edge, a suction hole opens.

60. An apparatus according to claim 26, wherein the revolving carrier is formed by a ring having the perforated surface provided on its inner side, the opening cylinder of the separating device arranged inside said ring, being arranged adjacent said inner side, and wherein adjacent the outer side of the perforated surface the suction nozzle is arranged.

61. An apparatus according to claim 29, wherein the fibre twisting device comprises, on the one hand, a frictional surface of the revolving carrier, which surface merges into the perforated surface and, on the other hand, a friction cylinder in a close but contactless relation to said frictional surface, the direction of rotation of said cylinder corresponding to that of the perforated surface.

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